Vol. 91, No. 17 New York, April 28, 1928 *Pages 847-896*

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Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician

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Editorial Service and the "Case Method"

GRADUATE schools of law and business thrive on the "case method" of instruction, by which the study of typical problems gives point to the application of major principles. More and more the pages of the ELECTRICAL WORLD are occupied by problems or cases from technical or commercial practice, and such generalizations as are permitted to appear in print are for the most part reasoned conclusions drawn from specific experiences analyzed for the good of the industry.

The value of illustrations in legal arguments, sermons and essays is paralleled in editorial comment, journalistic material of the "how to do it" kind, in surveys of practice and in analyses of theory. The case method has come to stay in engineering literature, and it is constantly leading the editorial staff of the ELECTRICAL WORLD into interesting and attractive fields in its search for new and better ways of serving the reader.

McGRAW-HILL PUBLISHING COMPANY, INC.
Tenth Ave. at 36th St., NEW YORK, N. Y.

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NEW YORK Dist. Office, 285 Madison Ave.
WASHINGTON, National Press Bldg.
CHICAGO, 7 South Dearborn St.
PHILADELPHIA, 1600 Arch St.
CLEVELAND, Guardian Building
ST. LOUIS, Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Bouverie Street, London, E. C. 4

Cable Address "Machinist, N. Y."
The annual subscription rate is $5 in the United States, Canada, Mexico, Alaska, Hawaii, Philippines, Porto Rico, Canal Zone, Honduras, Cuba, Nicaragua, Peru, Colombia, Bolivia, Dominican Republic, Panama, El Salvador, Argentina, Brazil, Spain, Uruguay, Costa Rica, Ecuador, Guatemala, Haiti and Paraguay. Extra postage to other countries $4 (total $9 or 38 shillings). Subscriptions may be sent to the New York office or to the London office. Single copies, postage prepaid to any part of the world, 25 cents.
Change of Address — When change of address is ordered the *new* and the *old* address must be given. Notice must be received at least ten days before the change takes place.

Copyright 1928
By McGraw-Hill Publishing Company, Inc.

Published weekly
Entered as second-class matter Jan. 20, 1907, at the Post Office at New York, N. Y., under the Act of March 3, 1879.
Printed in U. S. A.
Circulation of this issue, 19,450

Publishers of
Engineering News-Record — American Machinist
Power — Chemical and Metallurgical Engineering
Coal Age — Engineering and Mining Journal
Electrical Merchandising
Ingeniería Internacional — Electric Railway Journal
Bus Transportation — Construction Methods
Electrical World — Radio Retailing
Electrical West
(Published in San Francisco)
American Machinist—European Edition
Published in London

Member Audit Bureau of Circulations
Member Associated Business Papers, Inc.

Advertising Index—Alphabetical, 92; Classified, 86, 88, 90; Directory of Engineers, 42, 43; Searchlight Section, 44-49

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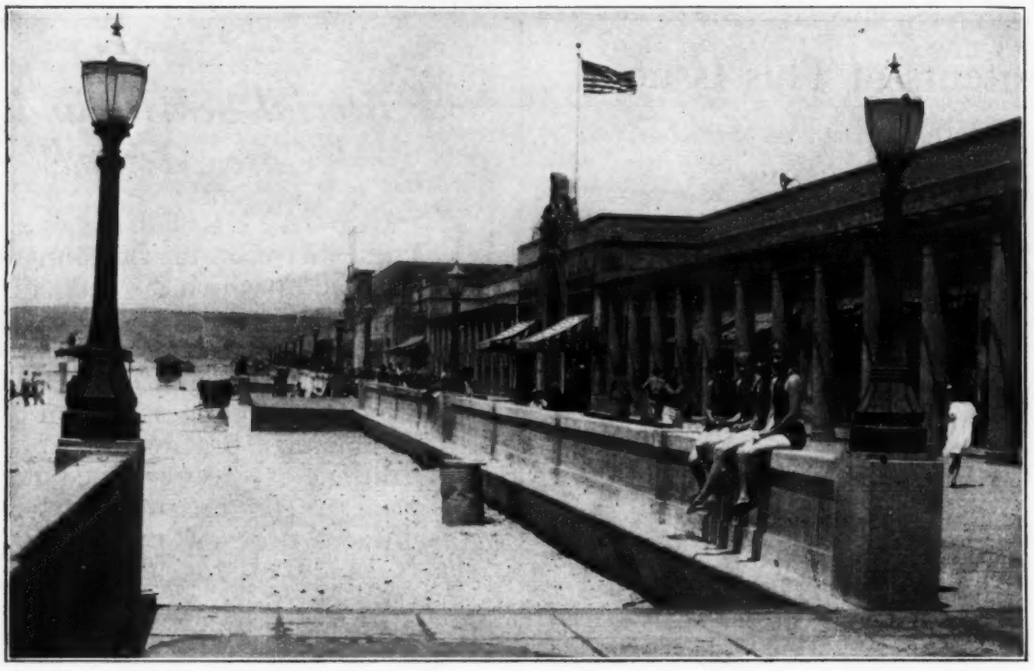

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Electrical World

McGraw-Hill Publishing Company, Inc.
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Editor

VOLUME 91 — *New York, Saturday, April 28, 1928* — NUMBER 17

Politics and Engineering

THE big tasks before Congress remain unfinished while the politicians spar for position in the presidential primary ring. Boulder Dam, Mississippi flood control and Muscle Shoals afford opportunities for the introduction of bills whose contents are designed to appeal to public sentiment. These projects are the excuses for congressional orations in which the orator defends the public from predatory interests with many mighty words. This is a typical presidential year.

Engineering and economic considerations should dictate legislation on Boulder Dam, flood control and Muscle Shoals. Engineering and economic facts should be established before money is spent or policies determined. The American Engineering Council has stated that Boulder Dam and flood control should be subjected to more thorough engineering investigation before legislation is enacted. A very able committee of the council reported only last week that the Boulder Dam project is not based on sufficient engineering data to establish its cost or its feasibility. Despite engineers and their reports, however, Congress is only too likely to discuss these projects with an eye to popular appeal and to enact legislation upon them which reflects political ambitions and not engineering data.

* * * *

A Good Investment in Managerial Time

NOT a few public utility managers regard attendance upon rate hearings as an unwarranted burden upon their normal activities. Such executives apparently believe in shifting the load to the shoulders of legal counsel whenever possible and confine their own participation to directing the preparation of cases. Granted that more than half the time spent in a hearing room is extremely irksome to an alert and energetic manager and that reliance upon the legal profession is essential to proper procedure, the fact remains that appearance before a public regulating body almost always carries within itself potential opportunities of the greatest value from the standpoint of public relations.

Press representatives at hearings listen closely to the utterances of executives, and the words of a straightforward, businesslike official daily concerned with the operation of a utility bear weight with commissioners and often reach front-page display space in local news sheets. Seldom indeed does a rate case terminate without an opportunity for a qualified executive to tell the story of the utility's aims and achievements to the people via the hearing room, and while constant attendance on protracted hearings is not essential unless the situation is critical, "absent treatment" is a risky proceeding. It should never be forgotten that the public is virtually always in favor of hearings, regardless of the subject matter, and to fail to capitalize these opportunities is to fall short of demonstrating the truth that the company has nothing to conceal but instead everything to reveal.

* * * *

Diversity Stabilizes Utility Investments

FROM the smallest central station serving a few score of customers in an isolated area to the investment group with far-flung properties half a continent or more apart, diversity underlies the operations and prosperity of all. The use of energy by customers supplied by a single-phase feeder illustrates the value of non-coincident demands on a little system serving a thinly settled rural region many miles away from another which provides power in blocks for densely grouped industries over cable trunk lines forming an interconnected set-up of great economic importance. Diversity is common to both. Go back to the immigrant's "lean-to" equipped with but two lamps and carry the element of diversified usage up the line to a completely electrified steel mill or railroad zone entering a metropolitan area. Non-coincident use of service is at the bottom of the capital outlay required to meet the needs of these customers without excessive cost. Upon the ability of the engineer to gage the relation between demand and plant investment required to render such service depends no small part of the success of the enterprise.

If the investor could trace the part which diversity plays in stabilizing the light and power business, he would be both amazed and brain-weary. The complex variations in usage of energy which are finally integrated into the plant or system load curve exhibit extraordinary differences in time and magnitude when analyzed even superficially with the aid of technical imagination. The transformation of these usage differentials into a total output burden which is finally equated into revenue from a system or group of systems marks a process of almost impregnable economic strength. The universality of electric service does not restrict its success in systems serving many customers of the same type unless expansion has run wild from the standpoint of capital outlays. Witness the high diversity factor of the electric range load in a single large apartment house. It is true that volume business must accompany diversity for economic success, and suitable rates are likewise basic. But those who market securities of light and power companies and those who buy them do well to reflect from time to time upon what diversity of demand and usage produces in

the way of stability of earning power. Given sound management—and by this is meant not brilliance of administration but good, thoroughgoing, competent direction of loyal and intelligent employee service—diversity will do its stabilizing work in the face of practically every obstacle except political interference; and with right public relations it is hardly too much to say that nothing but a cataclysm of nature can jeopardize success—and even then but temporarily.

* * * *

Why Does a Billion-Dollar Load Go Begging?

PROFESSEDLY, utility executives are keenly desirous of building industrial load on their lines. The enormous sums of money that have been invested in power plants and systems must show earnings. New loads and more intensive development of present applications for electric service must be sought. But with these conditions existing a potential industrial heating load amounting to millions of kilowatts and more than a billion dollars in annual revenue is virtually going begging so far as effective selling effort on the part of the majority of power companies is concerned. Some few electric utilities have taken definite and effective steps to set up in their sales departments a competent sales engineering staff to develop the heating load. For the most part, however, the central-station companies in their attempts at organizing an industrial heating department have "sent a boy to do a man's job."

Why does this condition exist? The manufacturers of industrial electric heating equipment want and need the sales assistance of the power companies. It is no fault of the utility power sales departments. They are doing the best they can with the equipment and personnel at their command. The real difficulty is executive failure to sense the possibilities of this class of business in load and revenue. The heating load properly developed means a large increase in revenue to the central-station industry. It is revenue not only for one year but for many years to come. Central-station executives would surely, therefore, find it profitable to map out and approve a plan to promote this business which could be followed through by their sales departments. Some electric utilities have already done this. Is it not time for many others to organize to do their share in the actual selling of this class of load?

* * * *

Carrier-Current Performance

THE use of carrier-current telephone systems is accepted; but the degree of acceptance is a variable depending on the kind of experience that has been had. Some operating men feel that the reliability of carrier communication has not been fully demonstrated. Some will state flatly that its complete lack of reliability has been proved to them. Others will admit that it has its deficiencies, but maintain that these deficiencies can be minimized to a point comparable to, or even below, the defects of wire communication and that carrier-current systems are perfectly workable and practicable.

There is a large interconnected system in the South that has grown very rapidly in the past few years. It covers such a large area that a private-wire telephone system would be very costly. A carrier installation was made at a much lower cost and has been used for load dispatching for about four years with perfect satisfaction. As a matter of fact, the assertion is made that the carrier communication is quieter during storms than the long-distance telephone. The experience of this company indicates that carrier communication cannot be satisfactorily maintained over open switches or through transformations. It has been learned that proper maintenance is necessary for satisfactory operation of the system. If the impossible is not expected of it and if it receives reasonable attention, carrier-current communication may be included in the scheme of operating procedure with every anticipation that it will perform acceptably.

Carrier systems are secondary lines of communication in most cases, and more and more it becomes apparent that the Bell system telephone lines should be relied upon for primary communication facilities. It is to be expected that the Bell engineers will develop their facilities to meet power-company requirements and that Bell executives will realize the value of the business available from light and power systems.

* * * *

What Is in the Atom?

SCIENTISTS are trying to unravel the inner structure of matter. They are using mathematics, physical analogies, chemical reactions, spectra and even lightning in order to find out what matter is made of. They have not found the answer to this problem, but they have found enough facts to cause them to throw about all the past laws and theories into the discard.

Among the first assumptions to be discarded were the old periodic system and the theory of immutability of the elements. Radioactivity did for these, because it gave absolute evidence that one element could transform itself into another. Once it was known that elements were destructible, it became necessary to attack individual atom structures, and now science is in the midst of trying to explain atoms and molecules so that it may have another and correct periodic system and another theory of matter that also is correct. Some progress has been made through the researches of Niels, Bohr, Stoner, Millikan and others, but there is a long, rough road still ahead.

Of interest to electrical engineers is the fact that the attack on the atom is premised on the atom consisting of positive and negative electric charges, and that experimental work consists of attempts to ionize atoms by electrical or chemical means. It is thought that the positive electric charges are bonded to the residual mass of the atom which we call matter, and on this assumption Rutherford developed the modern nucleus theory of matter. Then Van der Broeck, Moseley, Bohr and others readopted the century-old hypothesis of Prout according to which all elements are more or less complex aggregates of the element hydrogen because the hydrogen ion is the unit positive charge. So a new periodic table was set up based on the number of positive charges and negative charges in the atoms, and in this table the negative charges were added to make atomic weights equal atomic numbers. Then planetary laws were applied to the internal structure of the atom, definite mechanical arrangements of internal charges were assumed, and the two emission assumptions necessary to the axioms of the quantum theory of energy were added to give modern

atomistics. But a system of mechanics valid for such a system of atom charges is still unknown and the structure of all atoms is still unknown. We know only the structure of the atomic nucleus.

The whole mechanics of atomic theory is now undergoing a crisis, and the elaborate planetary structure and theory of Bohr is challenged. It is questionable whether a mechanical explanation of atomic and interatomic processes is needed, and recent work with the spectra and radioactive forces has developed data that require such a mass of corrective hypotheses to support the theory of mechanics that the whole principle is challenged.

Atomic structure is so bonded to the quantum theory of energy that a simultaneous solution of both must be had. We cannot yet devise an experiment to investigate the changes taking place within the atom. Our experimental tools themselves are atomic structures, and interatomic actions occur which prohibit conclusive experimental results. But the scientists are still undiscouraged, for the goal is very enticing. They should be encouraged in their work, for in it lie infinite possibilities for future engineering applications of value to civilization.

* * * *

The Answer to the Jobber's Problem

RECENT announcement by the executive committee of the Electrical Supply Jobbers' Association that the managing director appointed last November had withdrawn impresses once more upon electrical men the fact that distribution in this industry is sick and worried. It had been hoped that following a study of the jobber's problem by a fresh mind would come some plan to lead the wholesalers of electrical supplies and equipment out of the embarrassing morass and point the way to prosperity. But it is hardly to be expected that help will come from without nor yet from any effort to restore the good old times. The cure will have to come from within. The plan will have to be fashioned for the future—no matter what the past has been.

Fundamentally the value of the jobber of this industry—to any industry—depends upon the effectiveness of his warehouse and his delivery service. He is not cast in the plot as a creative builder of markets. His function is to collect goods from many sources into a local stock and deliver them in such assortment as the buyer desires. True, household appliances and radio both have been actively promoted by jobbers, but both these lines most fortunately became available in times of stress and were seized upon to save the situation. There will be many jobbers also who will continue to specialize in specialties, but, by and large, the jobber functions best as a distributor of staple lines, and that is where his best success has been made.

The answer to the jobber's problem will in the end be found in three directions probably—through a more accurate knowledge of his markets, through a more expert and economical operation of his warehouse and delivery service, and through more highly organized industry policies. Or it can be put in other words thus: By an intelligent use of complete industry statistics he will eliminate much present waste in buying, selling and in turnover. By a closer analysis of methods he will learn to reduce both his stock inertia and his territory and provide a more economic service. And by stronger industry co-ordination he will overcome some of the weaknesses of his present relations both with the manufacturer and with the power industry, for he will be able then to prove his worth.

No Moses can be expected to come from over the hills to lead the jobbers to a land of plenty. The function of distribution in the electrical industry waits for prosperity upon action by the jobbers themselves individually and as a group.

* * * *

Tremendous Trifles

THE importance of the small and relatively trifling thing has been told and retold—the shoe, the horse, the rider and the kingdom lost for the want of a horseshoe nail. Men, it has been said, stumble not over mountains but over molehills. The big job of the electric light and power industry is well recognized. Continuity of supply, steady voltage and service are symbols of the business. The less tangible matters are in a measure recognized under the title of public relations. Too often this is assumed to be a closed book when a director has been appointed and certain rules have been formulated. Commercial men, presumably, are those who come in contact with the customers most often and have been well trained; but meter readers, testers and inspectors, linemen and truck drivers are in continual association with consumers and the public. How can they aid in the job of fostering good relations with those they meet? How can they strengthen the tremendous trifles?

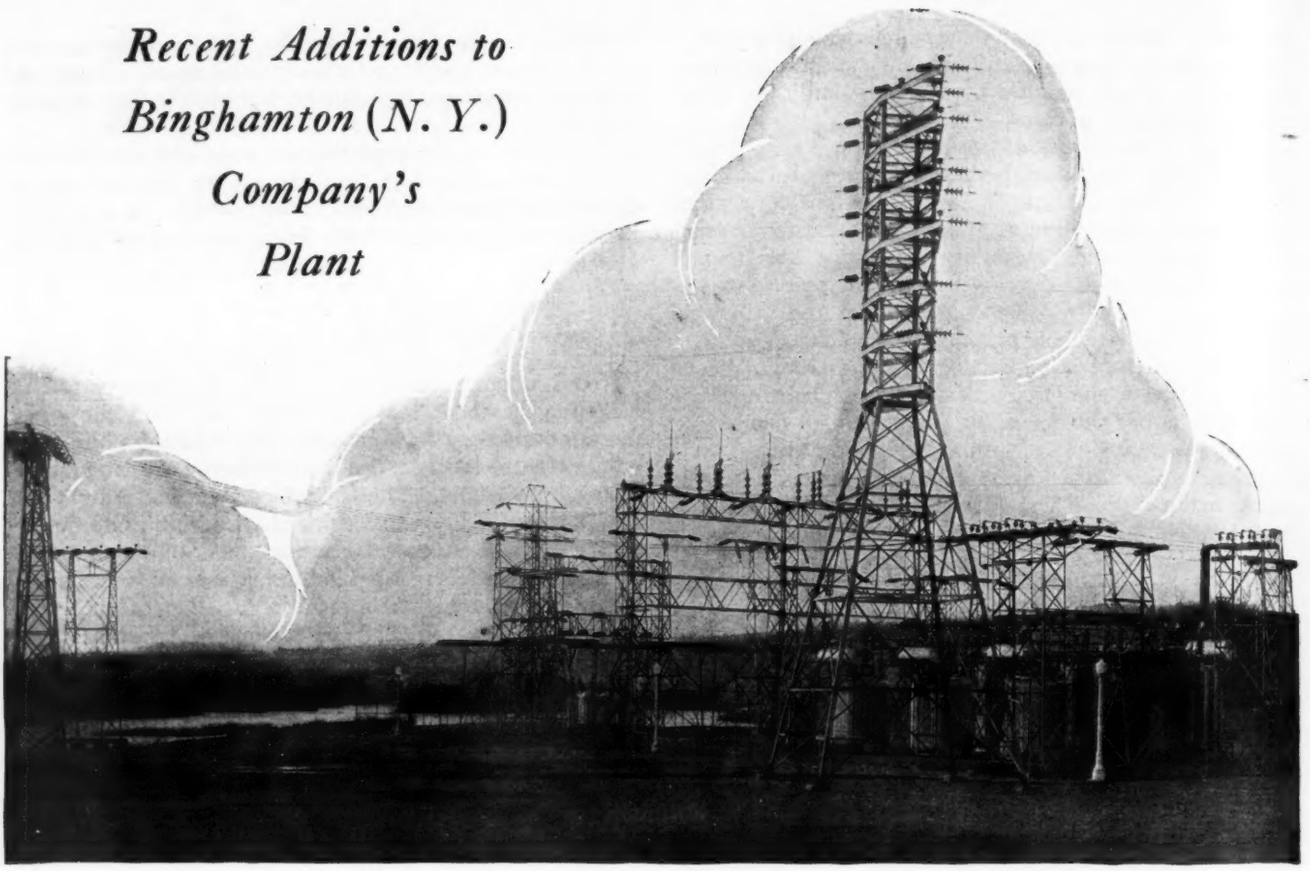
Electric utility men can learn a lesson from department stores, taxicab companies, railroads, up-to-date gasoline filling stations and hotels. Every meterman, every lineman and every employee engaged in similar work might well have a uniform. It should be trim and neat in appearance. It should be adapted to the occupational duties of the wearer and it should be kept in repair and clean condition. A uniform means business. It has an amazing reaction upon the psychology of the employee. If you doubt it, compare rides in taxicabs with uniformed and ununiformed drivers. Apparel often proclaims the—service.

* * * *

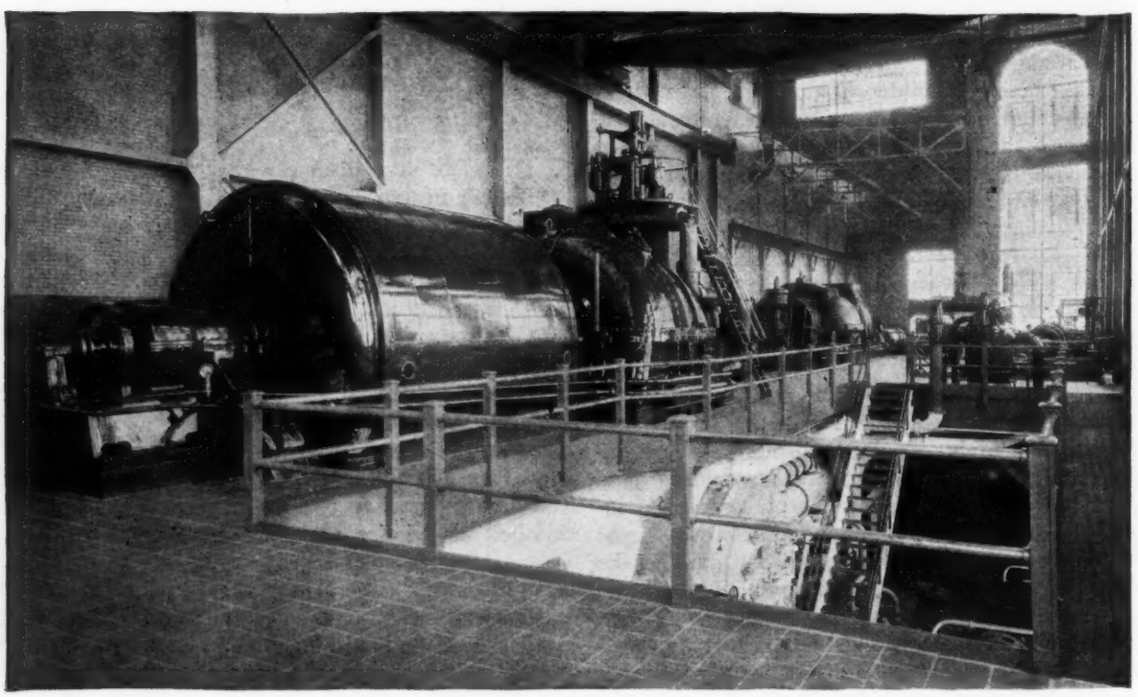
When Statistics Would Have Saved the Day

WHEN sales decline within a short time after a new manufacturer has entered the field the logical conclusion of the older manufactures, if they lack statistics on this situation, is that the new competitor is getting an unusually large share of the business. Often the result is that the older manufacturers reduce prices to meet the situation. An actual case last year resulted in a price reduction amounting to nearly one-third. The price cut in no way helped the situation. Had statistics been available, the manufacturers involved would have calmly awaited the facts and acted in accordance with the proper dictates. No one would have rushed to the false conclusion that somebody else was getting all the business and slashed his own price in a wild grasp for orders. The price standard of this product would not then have been demoralized. Therefore every manufacturer should heartily subscribe to the accumulation and publication of statistics on their products as an anchor of basic facts to tie to in times of trouble.

Recent Additions to Binghamton (N. Y.) Company's Plant



APPROXIMATELY $3,000,000 was spent last year by the Binghamton (N. Y.) Light, Heat & Power Company for additions to property and equipment. Installation of a 30,000-kw. turbo-generator at the main station in Johnson City, a 110,000-volt line to Elmira and two 110/33-kv. substations constituted the major additions. The new turbine and the step-down substation at the main station are shown. To provide for the new unit 82.5 ft. was added to the end of the turbine room and 115.5 ft. to boiler room. Four boilers burning powdered fuel were also installed.



Distribution "Revamp" Pays Dividend

West Penn Power Company makes changes, renewals and betterments that not only permit better service and provide for growth of load but bring directly or indirectly monetary benefits

By MERRILL DE MERIT

Distribution Manager West Penn Power Company, Pittsburgh, Pa.

GROWTH of load, depreciation of old equipment and demands by customers for better service periodically require changes, renewals and extensions of a distribution system. To delay such revamping usually results in an increased cost of rehabilitation when it is finally performed at the risk of impaired service and operating economy during the meantime.

Since July, 1923, the West Penn Power Company has approved work orders for revamping its distribution systems to an extent of $810,181, and it is estimated that similar work for 1928 will require $150,000, making the five-year total $960,181. Evaluations of the direct and indirect benefits of this work have fully justified the expenditure. Among the major benefits derived, which will be evaluated later, are reduced distribution operating expense, decreased energy losses, increased energy consumption and revenue due to higher voltage, lowered pole cost due to joint construction, improved service and reduction of accidents. Benefits to which a cash value cannot be so readily assigned include elimination of unsightly facilities, which hasten demands for underground service; improvement of customer's service, reduction of operating troubles and facility with which cause of trouble can be remedied, reduction in lost revenue due to interruptions and the minimization of accidents, with the resultant human suffering.

The computed annual saving due to the distribution revamp for the work done so far totals $264,619, distributed as follows: Decreased operating expense, $95,913; reduced energy losses, $30,705; increased revenue due to higher voltage, $87,514; decreased maintenance due to joint construction, $28,457; change to four-wire, 4,000-volt primary distribution, $22,030. Including the savings contemplated by the 1928 plans, the total annual savings will be $301,619.

To determine reductions in operating expenses, division managers who have operated distribution systems both before and after rebuilding were asked to estimate the savings in the sections revamped. Operating expenses are not subdivided by districts, so that direct comparisons of actual charges are impossible. However, by covering many towns and by discounting estimates liberally conservative figures have been compiled which indicate that annual reductions and operating expenses have averaged about 10 per cent of the debit revamp work orders, which figure has been used, subject, of course, to check in each instance.

One of the division managers who was called upon to enable a fair estimate made the following comment: "Previous to the revamp five and sometimes six men were employed continually, in addition to the short line crew. These men worked in ..... and ..... on maintenance and operation and did some construction. Previous to revamping one of the towns (by far the larger) these men were unable to do any construction work because they were so busy on maintenance and operation. One truck was required for these men. The saving would be about four men and one-half the cost of the truck."

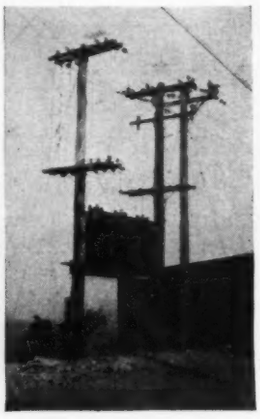
New trussed-steel poles shown to left of wood-pole line

The comment from another division manager reads: "Previous to the revamping six men and one truck were engaged continually for maintenance and operation of these districts in addition to the short line crew. These men did some construction work, but more overtime was spent on maintenance and operation than the entire time spent on construction."

In still another division the manager reported: "Eight men and one truck were continually engaged on maintenance and operation of these three districts in addition to the men who are now engaged on this work."

Each division manager advised that not only were these savings being made but that the service is better from the standpoint of interruption, and that additional interest is shown in safety work.

Evaluating these savings, they can be expressed as a percentage of the debit work order, averaged and applied



Ramshackle hillside substation gives way to elevated-platform transformers

to a large number of other revamp debit work orders made in exactly the same manner and under the same conditions. This method of calculating was used because operating and maintenance expenses are controlled more or less to follow the revenue, consequently direct comparison of charges before and after the revamp would not show the savings in expenses.

Decreases in energy losses were calculated from current and voltage tests and copper wire and transformer constants. Annual savings were thus evaluated with fair accuracy, considering such energy to be worth 1 cent per kilowatt-hour.

Increases in revenue due to raise in secondary voltages were estimated in two ways: First, by taking actual kilowatt-hour consumption increases in the districts revamped and attempting by graphical methods to eliminate changes due to other causes, such as addition of new customers, sales of appliances, changes in rate, etc.; second, by determining weighted average service voltage before and after revamping, calculating the average voltage increase and corresponding consumption and revenue increase. The two methods check quite closely and furnish a fair measure of the added annual revenue due to revamping.

Considering the first method, predictions were made for five districts, which were revamped, as to the consumption which would have obtained in 1926 if the districts had not been revamped. From this prediction and the actual consumption of these districts the actual increase in kilowatt-hour consumption due to revamping was determined. This consumption was evaluated at $0.035 per kilowatt-hour as the increased revenue due to revamping. By using averages a percentage has been determined which can be applied to future revamps. From this can be determined the increased revenue which is accruing due to the revamping which has been done and which will follow.

3,983 Pole Locations Eliminated by Joint Use

Yearly savings due to joint construction are considered equal to one-half the annual charges on poles jointly used. Assuming the average joint pole to be worth $35 installed and conceding annual charges of 15 per cent, the savings were calculated for joint construction. It may be pointed out that up to 1928 during this rehabilitation period 12,207 poles were converted to joint use and 3,983 pole locations were entirely eliminated through improved layouts and planning.

In fourteen towns where the primary distribution was changed from three-wire, 2,300-volt to four-wire, 4,000-volt a total annual saving of $22,030 was made by eliminating 2,300-volt circuits, involving 161 wires valued at $151,347, and by saving pole space valued at $48,680. The net saving in capital expenditure was $200,027, giving the annual saving mentioned before of $22,030. In addition to the saving in distribution equipment, substation savings resulted because of reduced circuit positions, switches, regulators, etc. Saving in investment for these causes is estimated at $186,000 and result in annual savings at 11 per cent of about $20,000. (Not included in totals which are for distribution only.)

The changes which brought about these benefits involved the redesign of the distribution system to meet modified standards as to primary circuits, transformer layouts, secondary circuits, pole plants, joint construction, elimination of hazards and corrections to meet present specifications. The relative importance of these factors varied on different parts of the system and the total money available determined the degree of perfection of physical and operating conditions aimed at by the

Effect of Revamp on Future Work

By the time all West Penn distribution systems have been revamped new conditions will prevail in two major respects: First, the system of continuous design will have simplified and smoothed out the process and quality of revamping necessary. Second, completed maps and records will have reduced the field work and expense necessary to determine accurately the conditions of distribution systems and need for improvement. Consequently, revamping will eventually become a continuous rather than a periodic process to which a schedule can be applied that was impractical heretofore.

For example: (1) Bad conditions will be eliminated and changes made in accordance with future plans, so that operating hazards and expenses will be reduced at the same time that capital expenditures for future additions are made; (2) increases in revenue due to revamping will accrue to the company continually instead of in jumps at times of general revamping; (3) more effective testing will enable more exact and better designs and the cost of testing will be reduced, because only one-third of the system need be tested each year; (4) revamping of construction will produce an improved load factor in construction; (5) with the aid of map records, revamping work can be accurately budgeted and expenditures anticipated; (6) the engineering work can also be budgeted and provided for in a better manner and at less expense for corresponding improvements; (7) additions made at any point in the system will fit in more closely with general plans than at present; (8) joint planning and joint construction work can progress to the best advantage and can be co-ordinated.

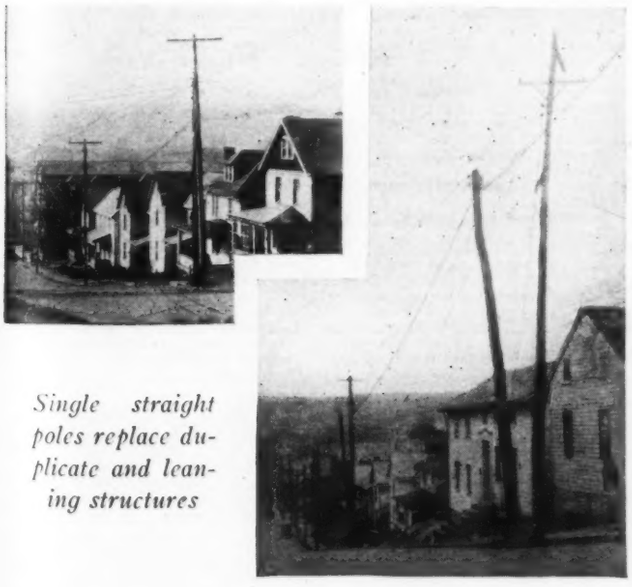
design. To date rehabilitation has attempted to correct undesirable conditions in the order in which they would render the greatest return for the money expended upon such improvements.

Selection of the primary voltage was based on existing voltage, tree conditions, distance from substations to load centers, availability of other voltages, rate of growth and cost of changes. With the voltage determined, the next decision was whether to use the "main feed and branch," "segregated territory" or "feeder and network" primary system. Distribution of the present and prospective loads and location of the existing primaries determined considerations at this stage.

Large savings in transformer capacity were made possible by taking advantage of the fact that it is both safe and economical to carry loads up to 160 per cent of the nameplate rating.

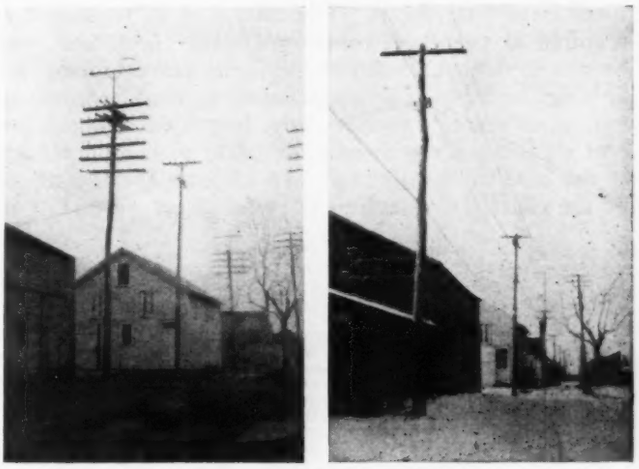
Four-Wire, 4,000-Volt Primaries

In nearly all West Penn towns the primary distribution circuits before revamping were operating at 2,300 volts. In many of the larger towns it has been found economical to change to three-phase, four-wire, 4,000-volt systems. In general, the advantages of this system accrue from the fact that the effective distribution voltage is really 4,000 volts, although 2,300-volt transformers and other equipment may still be used. In addition, the 4,000-volt system requires only about 44 per cent of the copper necessary in a 2,300-volt system for the same power transmitted and the same percentage of losses. Actually, one neutral conductor is used for two or three circuits and the saving is greater. Consequently, the number of circuits after substituting the 4,000-volt system is only one-third of that required for 2,300-volt operation. Consideration was also given to the disadvantages of the 4,000-volt system, such as the higher voltage and the grounded neutral. During stormy weather bad tree conditions and other weak points in insulation cause grounds and consequently short circuits. However, when such weak points have once been cleared operation is found to be as reliable as that secured with lines operating at the lower voltage.



Single straight poles replace duplicate and leaning structures

In many of the districts larger amounts of money than were authorized would have been required to bring the distribution to its ultimate standard immediately. However, a system of progressive or continuous rehabilitation has been incorporated so that a general revamp would not again be required. Essentially, this plan enables caring for future business by making additions rather than replacements. This procedure is particularly advantageous in selecting transformer capacities and locations because of the high rate at which domestic and commercial load densities are increasing. Since lighting loads are at a maximum for only a few hours each day, the possibility of carrying the peak at much greater than the continuous rated capacity of the transformer without exceeding prescribed temperature rises was recognized.



Alley construction cleared up

Secondaries Follow Primaries

Tests and analyses developed several guiding principles for the design of secondary distribution circuits. These include proper use of two-wire and three-wire secondaries and economical location of transformers along the secondaries. In general, the line type of distribution is used with primaries following secondaries. Transformer locations were planned about every 500 ft. on No. 6 wire and every 700 ft. on No. 4 secondaries. Poles of sufficient height were installed at such locations where new poles were found necessary.

Continuous or progressive design is particularly valuable for secondary circuits. Replacement of secondaries is costly, so new loads should be cared for, first, by placing intermediate transformers on existing secondaries, and, second, if required, by replacing transformers with units of double capacity. The secondaries will then be carrying double the original load, but for only half the initial distances, and it would still be adequate although the total load served is 400 per cent of the initial load on these distribution facilities.

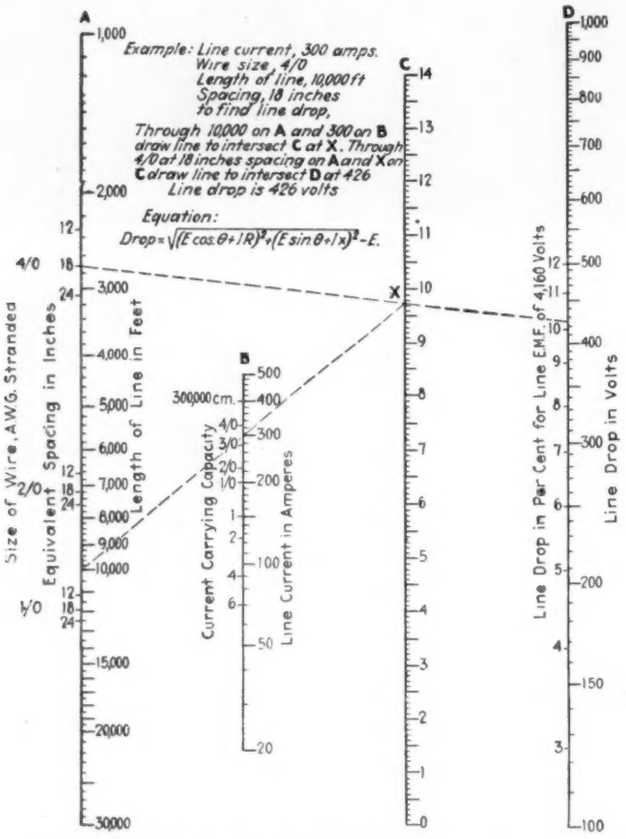
Expenditures for pole changes came under two general classifications: Those providing for joint construction of the utilities and those necessary because of depreciation and changes in pole sizes. Joint construction has been provided in most places except on main leads away from substations or where voltage or peculiar local conditions made independent pole lines preferable.

Dangerous conditions resulting from either depreciated equipment or inadequate clearances have been eliminated as discovered. Much unsightly plant has been replaced, particularly the offensive cases, but these changes were justified by other causes alone.

Feeder Layout Chart

By R. W. Jickling and T. A. Robinson
Assistant Electrical Engineers
City of Winnipeg Hydro-Electric System

IN LAYING out residential feeders it was found that the same calculation had to be repeated a great many times in varying forms. The volts drop or regulation is required at peak-load conditions. This peak load may be assumed as at least 95 per cent power factor for lighting feeders. The variables to be chosen from are wire size, current, voltage drop, length of line and per cent capacity of regulator required to give good voltage at the base of distribution. To increase the usefulness of the chart the volt drop is given direct instead of in


Example: Line current, 300 amps.
Wire size, 4/0
Length of line, 10,000 ft
Spacing, 18 inches
to find line drop,
Through 10,000 on A and 300 on B draw line to intersect C at X. Through 4/0 at 18 inches spacing on A and X on C draw line to intersect D at 426
Line drop is 426 volts
Equation:
Drop = √[(E cos θ + IR)² + (E sin θ + IX)²] − E
A
B
C
D
Size of Wire, A.W.G. Stranded
Equivalent Spacing in Inches
Length of Line in Feet
Current Carrying Capacity
Line Current in Amperes
Line Drop in Per Cent for Line EMF of 4,160 Volts
Line Drop in Volts
300,000 cm.
4/0
3/0
2/0
1/0
1/0
X

Enables estimating voltage drop in three-phase lines at 95 per cent power factor and balanced load

per cent of a certain line voltage. This means that the chart may be used for a 2,400-volt or 4,160-volt feeder equally well. The per cent drop for 4,160 volts is, however, shown in addition.

Starting with any one of the quantities, it is extremely easy to get the others without any intermediate calculations, as is necessary with most charts of this type.

The chart is based upon the following conditions:

Three-phase lines, at 95 per cent power factor, balanced load.
Spacing, 12, 18 and 24 in., being the equivalent spacing, or spacing of three wires in a delta arrangement.
Wire sizes, 1/0 to 4/0 stranded.
Current, 50 to 500 amp.
Distances, 1,000 to 30,000 ft.

The resistance of wire is taken at 20 deg. C. and for 97 per cent conductivity copper, as given in the N.E.L.A. overhead systems reference book.

Reactance for 60 cycles is as given in the N.E.L.A. systems reference book.

The allowable carrying capacities shown are the National Electrical Code standard for weatherproof wires.

Equation of drop = $(E\cos O - IR)^2 - (E\sin O - IX)^2 - E$

The chart, if carefully used, is accurate to within 2 per cent. If one considers how much the quantities themselves are likely to vary, this is quite sufficient for most ordinary purposes.

Supervisory Equipment Inspections

By O. M. Ward
Assistant Electrical Engineer Milwaukee Electric Railway & Light Company, Milwaukee, Wis.

THE IMPORTANT functions performed by supervisory equipment requires that this kind of apparatus be kept always tuned to perfect operation. The only way that this end can be attained is by frequent and sedulous attention. The report form reproduced here testifies to the detail of the inspections of supervisory equipment which are made at intervals of one week on the system of the Milwaukee Electric Railway & Light Company. A copy of this report for each inspection is kept in the substation so that previous conditions of the apparatus are known at every inspection.

INSPECTION REPORT OF SUPERVISORY EQUIPMENT

Station ..... Date .....
Reg. & Drive Panel. Mech. Oper. .... Elect. Oper. .... Contacts ....
Connections ..... Fuses ..... Condenser ..... Resistances .....
Remarks .....
Oper. Control Panel. Mech. Oper. .... Elect. Oper. .... Contacts ....
Connections ..... Fuses ..... Resistances .....
Remarks .....
Control Panel No. 1, Points No. 1 to 10. Mech. Oper. .....
Elect. Oper. ..... Point selecting relays .....
Individual A, B, C, relays .... Contacts .... Step over relays ....
Connections ..... Fuses ..... Toggle switches .....
Test breaker and reset ..... Test breaker relays J, S, L, A .....
Remarks .....
Control Panel No. 2, Points No. 11 to 20. Mech. Oper. .....
Elect. Oper. ..... Point selecting relays .....
Individual A, B, C, relays .... Contacts .... Step over relays ....
Connections ..... Fuses ..... Toggle switches .....
Remarks .....
Control Panel No. 3, Points No. 21 to 30. Mech. Oper. .....
Elect. Oper. ..... Point selecting relays .....
Individual A, B, C, relays .... Contacts .... Step over relays ....
Connections ..... Fuses ..... Toggle switches .....
Remarks .....
Control Panel No. 4, Points No. 31 to 40. Mech. Oper. .....
Elect. Oper. ..... Point selecting relays .....
Individual A, B, C, relays .... Contacts .... Step over relays ....
Connections ..... Fuses ..... Toggle switches .....
Remarks .....
Insulation Test Between Iron Frame and Cabinet .....
Remarks .....
Current Transmitter, Ammeter. Contacts ..... Connections .....
Motor ..... D'Arsonval element .....
Kelvin balance element ..... Rheostat .....
Remarks .....
Current Transmitter, Voltmeter. Contacts ..... Connections .....
Motor ..... D'Arsonval element .....
Kelvin balance element ..... Rheostat .....
Remarks .....
M.C. Relays. Transformer ..... Main Bus ..... Auxiliary Bus .....
M.S. Relays. Line No. 3411 ... Line No. 3422 ... Line No. 3433 ...
Line No. 3444 ... Line No. 3455 ... Line No. 3466 ...
Transformer .....
Motor Generator, 125 Volts. Motor Generator, 48 Volts.
Bearings ..... Brushes ..... Bearings ..... Brushes .....
Mech. Oper. .... Elect. Oper. .... Mech. Oper. ..... Elect. Oper. ....
Relays & Contactors ..... Relays & Contactors .....
Contacts ..... Contacts .....
Remarks .....
Protective Equipment .....
Dispatcher's Control Panel. White and black alarm lamps .....
White stop lamps ..... Red lamps ..... Green lamps .....
Control Keys, Twist Type. Stop key ..... Start key .....
Reset key ..... Master control key ..... Alarm release key .....
Alarm buzzer ..... Ammeter check ..... Voltmeter check .....
Synchronous Clock. Time setting .... Contacts .... Connections ....
Insulating Test Between Steel Panel and Ground .....
Remarks .....
Condition of Building and Property. Roof ..... Yard .....
Fire Extinguisher ..... Cabinets .....
High Tension equipment ..... Leaky insulators .....
Air Break Switch .....
Remarks .....
.....
Inspector .....

What Is the Matter with

Industrial Electric Heat?

A billion-dollar load goes begging in the electrical industry. Study of existing conditions shows how the power companies can cash in on enormous new-business possibilities

By T. P. KINDIG
Western Editor ELECTRICAL WORLD

THAT the power industry should be vitally interested in building up the industrial electric heating load there can be no question. Every kilowatt of this class of business means additional load and revenue for the central-station company. There are at least 50,000,000 kw. of this type of load which should be connected to the central-station company's lines. This load would consume, in round numbers, 100,000,000,000 kw.-hr. per year and return about $1,250,000,000 gross annual revenue.

Yet with these possibilities staring it in the face, the power industry—in fact, the entire electrical industry—seemingly regards the heating load with lackadaisical indifference. The efforts put forth to get this business are puerile and infinitesimal in proportion to what it means not only in the sale of kilowatt-hours but also the sale of electrical equipment to supply and control the use of energy for heating purposes. Why does such a condition exist? What is the matter with industrial heating? Why doesn't it go ahead faster? Whose fault is it?

A review of the present status of industrial electric heating from the standpoint of the manufacturers of heating equipment reveals some most interesting and rather startling conditions in the attitude of power companies toward this class of business. The heating-equipment manufacturers believe that the central-station companies are of great potential value in developing the use of industrial electric-heating apparatus. In fact, they believe the power companies should be the ones most concerned in seeing these installations multiply, because they will receive the revenue from energy consumption year after year, while the equipment manufacturer must realize his profit from the direct sale and orders for additional apparatus. However, the manufacturers of industrial heating equipment have found that there is still much to be desired in the attitude and degree of assistance that should be expected from the local central-station company in the sale and installation of this type of apparatus. In many cities the manufacturer, while desiring its co-operation, is reluctant to have the local power company participate in the negotiations with the customer.

That such a condition should exist is difficult for many power company executives and heads of commercial departments to believe. But facts cannot be denied. The experiences and opinions set forth in the following paragraphs have been placed before a number of utility executives and power sales engineers who have admitted that many of the conditions were true in their own companies. Also, in their opinion the utilities as a whole are putting very little effort back of industrial heating and much of this effort is ineffective and sometimes detrimental.

An examination of the facts shows that despite the enormous load and revenue which would accrue directly to the central-station companies, these very companies are themselves chiefly to blame for the relatively slow rate of growth of the heating load. In a large number of cases installations of industrial electric heating equipment have been made almost in spite of rather than because of any practical assistance from the power companies. That this is true would appear to contradict the fact that the utility sales departments have long recognized the value of the heating load and are striving with what available tools they have to get the business. But the fault does not rest with the utilities' power sales departments.

SENDING A BOY TO DO A MAN'S JOB

Failure to develop the heating load must be laid on the doorstep of the utility executive. In more ways than one the man upstairs in the front office has hindered rather than helped the installation of electric heating apparatus in the manufacturing plants of his customers. More than that, in most instances where the utility executive has finally consented to the addition of a special "heating man" to the sales force he has in effect "sent a boy to do a man's job." As a matter of fact, the power companies which have anything even approaching an adequate industrial heating sales force can be counted on the fingers of one hand. Here is a class of business which when properly developed will total two or three times the present motor load. However, the sales engineering support which a utility company will give to industrial electric heating is usually in inverse ratio to the potential volume. The power company has, say, five power sales engineers, and if it is well equipped, as utilities go, it may have one man who devotes his time to industrial heating.

Power companies are anxious and eager, wherever possible, to add to their motor load, but when the question of a heating load comes up there develops a surprising and unexplainable indifference on the part of the utility executive. This leads to the question, Are hot kilowatts less desirable to the power company than cold ones? Does it mean that the dollars received for energy used in an electric furnace are less profitable than those that

go through an electric motor? It doesn't require a lengthy analysis to show the value of the heating load. Its high power factor and high load factor characteristics, together with frequent possibilities for off-peak operation, make it undeniably a desirable class of business.

Perhaps it is the sale of energy in large single blocks that has appalled some utility executives. A fair-sized electric furnace has a large demand and in twenty-four hours will consume a surprisingly large number of kilowatt-hours. Quite often individual installations of electric furnaces run into thousands of kilowatts. Recently the installation of a single heat-treating furnace called for a demand of 3,000 kw. This furnace is being operated 24 hours a day and is connected to the lines of one of the few power companies that is intelligently encouraging and building the heating load. In developing the installation of this furnace the manufacturer worked very closely with the local power company and its customer and the resultant operation of the furnace is highly satisfactory from every standpoint. However, contrast the attitude of this power company with that of the utility in another city where the same furnace builder tried to work with the local central-station company in the sale of heating equipment.

He first went to the power company to obtain its schedule of rates. He met with a cold reception and was told that the prospective customer could not have a primary power rate. Why? Because, the utility vice-president said, "an electric furnace load could not earn the rate." It took the furnace manufacturer half a day finally to convince this executive that the furnace which he proposed to install on the customer's premises not only was entitled to such a rate but that it would give the power company a more desirable load than many power loads which it already was serving under the same rate.

But that was not all. After the question of rate had been settled the manufacturer visited the power sales department, thinking that here he would be able to obtain the necessary information concerning power and service conditions in the customer's plant and that at least the power sales department would be glad to know of this prospective heating load. This is the reception he received at the hands of the power sales department. He was told that the power company did not want any furnace manufacturer "messing around" with its customers. Any negotiations to be carried on with this customer must be through the power company. In other words, this furnace manufacturer could not try to sell an electric furnace in that town.

It is no wonder that this electric furnace manufacturer says of the power company, "If you want to lose a sale or have it go gas or oil try to work through the power company. To sell an electric furnace in that town, get in, sell it, get out, install the furnace and when ready for service then tell the power company."

Special Rate Not Wanted

There is an idea on the part of some power company executives that the manufacturers of electric heating equipment desire that special low rates should be set up for energy used for heating purposes. This is not true. What the electric furnace manufacturers do want is that the electric heating load shall be served at the standard power rate which will give the customer the benefit of high load factor and high power factor operation. Certainly a load which operates at very nearly unity power factor and has a yearly load power factor of 40 to 50 per cent should be more desirable to the utility company than a load whose power factor is under 75 per cent and whose annual load factor is less than 25 per cent.

Frequently the sale of an electric furnace is lost to some type of fuel-fired furnace. This happens not always because of the severe competition from the fuel-fired furnace manufacturers but because the power company has not wholeheartedly backed up the recommendations for electrical equipment. Again, the power company in endeavoring to get the customer the best proposition in the price of the furnace has called in several manufacturers. Different types of design and varying prices have been presented, and in the end a gas or oil furnace manufacturer walks off with the order. The power companies should provide themselves with industrial heating men who are sufficiently well equipped with a knowledge of the customers' needs and the electrical equipment available in the market so that they can recommend to the customer one or two manufacturers best fitted to supply the particular requirements. It is well for the central-station company to realize that a furnace manufacturer who builds both electric and fuel-fired equipment prefers to recommend electrical equipment. The profit is just as great and the manufacturer is more certain that the electric furnace will meet and hold up to specifications.

Training of Salesmen Inadequate

In a number of instances where the power companies have delegated one or more men to handle the industrial heating business in the territory the training and experience of these men has been totally inadequate. It is true that competent and experienced heating men are scarce and the facilities for training men for such highly specialized work as the sale of industrial heating equip-

Some Questions for Utility Executives to Answer

What have you done to develop the industrial electric heating load in your territory?

Are you sending a boy to do a man's job?

Are hot kilowatts less desirable than cold ones? And why?

Don't the power companies understand big business?

Do you know how much potential heating load there is in your territory?

Do you know how much gross annual revenue the heating load would add to your company's income?

Why, when the ratio of potential heating load to available power load is three to one, is the ratio of heating sales to power sales engineers one to three?

Why does the heating equipment manufacturer want and at the same time fear the sales assistance of many electric utilities?

What are the central-station companies going to do to right this situation and help get this business on their lines?

ment could be greatly improved. Much credit must be given to the industrial heating committee of the National Electric Light Association, which has co-operated with the electrical manufacturers in holding a two weeks' training course each year where utility power sales engineers could study the theory and practice of industrial heating application. It could not be expected, however, that these courses would provide the power salesman with a complete working knowledge of the intricacies of industrial heating application. Some further practical experience is necessary, for, verily, a little knowledge is a dangerous thing in the hands of a novice. The man who is going to sell industrial electric-heating equipment needs to have, more than anything else, a very practical knowledge of the manufacturing processes in the industrial plant where the furnace is to be installed. The successful installation of an electric furnace does not depend upon a theoretical knowledge of either electrical or thermal formulas but, rather, a very practical knowledge of the production problems of an industry.

Development of electric heat-treating processes to their present state of practical and economical application has been possible largely through the persistent efforts of furnace builders working with the industrial plant operators to design equipment which would fit into production schedules and improve manufacturing processes. Credit for this development work must go mainly to the heating equipment manufacturers and to the industrial plants which have been willing to accept such a revolutionary change in heat-treating methods as the adoption of electrical equipment. Outstanding in electric heating development by central-station companies has been the work of the Milwaukee Electric Railway & Light Company and the Detroit Edison Company. What these two companies have done serves to illustrate what can be accomplished by an electric utility to promote the use of industrial electric heating in its territory.

Constructive Suggestions Made

The need for broader training of industrial heating sales engineers and the responsibility for the extent of development to date are cited to show where it is possible for the central-station company to take a more active and profitable part in the promotion of this class of business.

Still another direction in which the electrical industry has been negligent in the development of the heating load has been its failure to lay out a comprehensive publicity program to promote this load. There has been no provision for promoting industrial electric heating through publicity, as has been done by the gas industry for the promotion of industrial gas.

Central-station executives should see to it that a careful survey is made of all industrial plants in their territory in order to evaluate the extent of the potential industrial heating load. They should determine what this amounts to in additional kilowatts and gross revenue and then set up a force of industrial heating specialists in proportion to the volume of business.

Sales engineers who are to specialize on this class of business should not only receive the instruction and training available through the N.E.L.A. industrial heating courses but some provision should be made whereby these men could receive practical experience both in the plants of the electric-heating equipment manufacturers and in the operation of these furnaces in industrial plants. Such training and experience would necessarily mean considerably more than mere inspection trips and should provide the men with actual working knowledge of the equipment.

Power companies should be careful to see, in recommending rates for the industrial heating load, that the rate schedules provide some reward to the user when warranted by high load factor and high power factor operation.

The power company and the manufacturers of electric-heating equipment should get together on a basis of closer co-operation not only in the sale of heating equipment but also in a well-thought-out educational and publicity program, some of this education and publicity to be directed toward the power companies themselves.

What the Load Means

Every kilowatt of industrial electric heating load put on the lines of the central-station company means an added revenue of $30 to $40 per year, which will continue for many years. For every kilowatt of industrial heating equipment installed there must be provided from $100 to $200 worth of other electrical equipment, including generating, transmission, distribution, metering, wiring, control and other apparatus. Or, putting it another way, every dollar spent for industrial heating apparatus means that about $5 additional must be spent for electrical equipment to supply and control its operation.

What Utilities Can Do to Develop Industrial Electric Heating

Get a true conception of the extent of this load in kilowatts and its value in dollars of gross revenue.

Give the utility sales department ample sales engineering personnel to handle potential business.

Encourage sales engineers to specialize in practical knowledge of industrial heat applications and where they fit into industrial processes.

See that rate structures are so drawn as to reward high load and high power factor when earned by heating load.

Stand back of furnace manufacturers' recommendations to customers.

Don't open the way for a fuel-fired installation by asking too many electric furnace manufacturers to specify and bid on the same job.

Don't try to recommend standardized equipment where special design and engineering are required.

Get together with the electric furnace and equipment manufacturers on a joint advertising and publicity program to develop the heating load.

Remember that the central station company is the greatest single influence for developing the electric business in its territory and act accordingly.

A picture of the industrial heating business looks about like this: There is a 50,000,000-kw. load which would earn at least $1,250,000,000 for the power companies. There is $2,000,000,000 of electric heat-treating equipment to be sold by the manufacturers of this type of apparatus. There will be $10,000,000,000 of generating, transmission, control and miscellaneous apparatus necessary to supply energy to this load. Both the central station and manufacturing branches of the electrical industry can ill afford to overlook this business much longer. They should stop hunting elephants with popguns and quit sending boys to do a man's job.

Regulator Protects Penstock on Fluctuating Loads

Feeder regulator mechanism actuates water rheostat to maintain minimum water velocity in long penstock of small hydro plant

By S. C. Lindsay
Assistant Electrical Engineer
Puget Sound Power & Light Company, Seattle, Wash.*

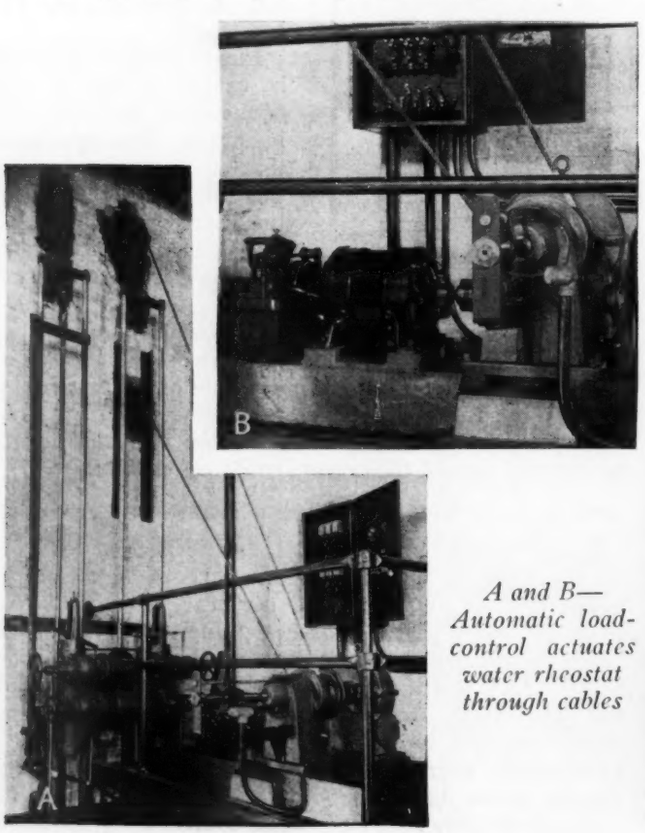
PRIOR to the electrification of the Great Northern Railway between Skykomish, Wash., and the old Cascade Tunnel the Tumwater hydro-electric plant of the railway company was used to supply energy for hauling trains through a tunnel approximately 2 miles in length. The load varied from about 800 to 4,000 kw., with somewhat rapid increases in demand when accelerating trains and sudden decreases when the trains were through the tunnel.

The turbines in the generating plant are supplied through one wood-stave pipe line 8 ft. 6 in. in diameter and 11,832 ft. in length. The original design of the plant included a hydraulic governor mechanism, combined with an induction motor sensitive to frequency variations, which operated a water rheostat automatically to maintain a minimum load on the generators when trains were not in operation. This loading device was for the purpose of maintaining a minimum velocity of water in the pipe line to prevent it from collapsing upon sudden load demands. The plant is also equipped with a surge tank of limited capacity which assists in performing the same function.

The operation of the plant was fairly satisfactory, but when the Washington Electric Company agent took over its operation in connection with increased power supply for the railroad the old emergency loading system, which functioned through frequency and water pressure, was no longer adequate. The increased demands of the railroad required that the Tumwater plant be paralleled with the Puget Sound Power & Light Company's 60-cycle system through frequency changers which gave practically a fixed frequency. Under these conditions, the problem was to find a regulating mechanism that would operate automatically to maintain a minimum load on the generators as a function of trail-load kilowatt demand. Operating experience had shown that a minimum load of 1,800 to 2,000 kw. on the plant would permit rapid acceleration of trains without excessive demands on the pipe line.

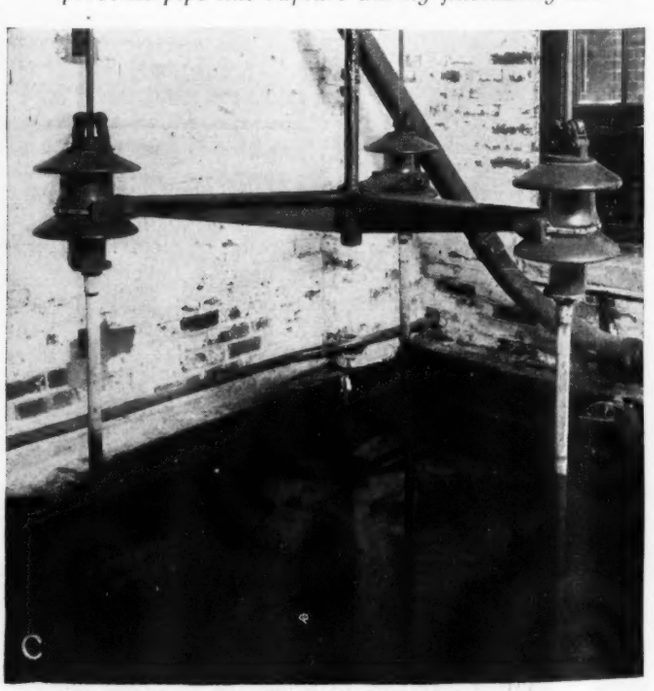
The device consists of a single-phase voltage regulator which through intermediary of a motor-driven cable drum raises and lowers the electrodes of a water rheostat. In the feeder regulator equipment a contact-making wattmeter was substituted for the contact-making voltmeter. The wattmeter is a polyphase curve-drawing instrument having special contacts to which the control circuit of the regulator mechanism is connected. A dead point exists in the scale between the 2,000- and 2,500-kw. load points, which prevents the electrodes of the water rheostat from continually traveling from one position to the other.

**Under executive management of Stone & Webster, Inc.*

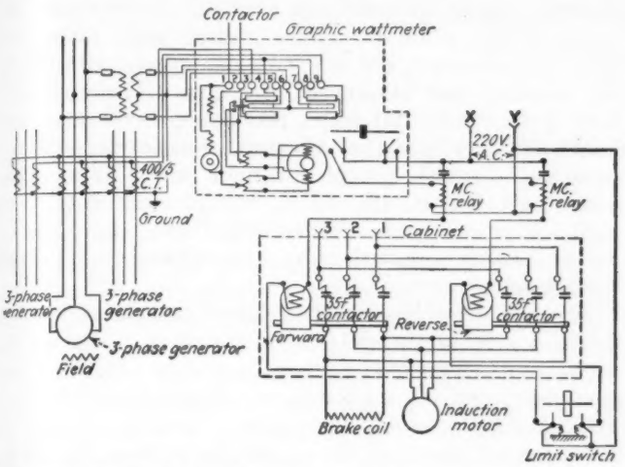


A and B—Automatic load-control actuates water rheostat through cables

C—Automatically actuated 6,600-volt water rheostat prevents pipe line rupture during fluctuating load



When the load is more than 2,500 kw. the device does no regulating and the electrodes are out of the water. When the load drops below 2,000 kw. the electrodes are lowered to a depth that will hold the load to approximately that value. For total generator loads of 2,000 kw. the division of load between the railroad and the loading rheostat may be anything from 100 kw. on the



Connections of special curve-drawing wattmeter which actuates feeder regulator controlling water rheostat

rheostat to 1,900 kw. on the railroad, or 100 kw. on the railroad to 1,900 kw. on the rheostat. The device will regulate for load changes of 50 kw. and can be set to regulate more closely, if desired.

A motor drives a shaft carrying an 8-in. drum on which is wound the cable for raising and lowering the electrodes. An extension of the shaft carrying the drum is threaded and carries a nut which operates the limit switches. A 3-hp. motor is so geared that the rate of travel of the electrodes is approximately 1 ft. per second. An electrode speed of 1½ ft. per second, first tried, proved too fast, as the device did the governing for the plant, instead of the waterwheel governors, at loads less than 2,000 kw.

The rheostat tank is concrete, 8 ft. x 9 ft. by approximately 10 ft. deep. The electrodes are 1¼-in. iron pipe spaced on an approximately 3-ft. equilateral triangle and directly connected to the 6,600-volt generator bus through an oil circuit breaker. A small quantity of water from the penstock is kept flowing continuously through the tank to keep the temperature down. The resistant is maintained low enough to carry a load of 2,000 kw. when the electrodes are fully immersed by a salt solution, admitted to the rheostat tank as required by the station operator.

The water supply for the plant is in excess of load requirements for several years to come, which led to the adoption of this scheme. The installation was made at a cost not exceeding $1,500, as compared with estimated costs of from $10,000 to $12,000 for other schemes considered. The device has been in operation since Feb. 1, 1927, and its performance has been highly satisfactory.

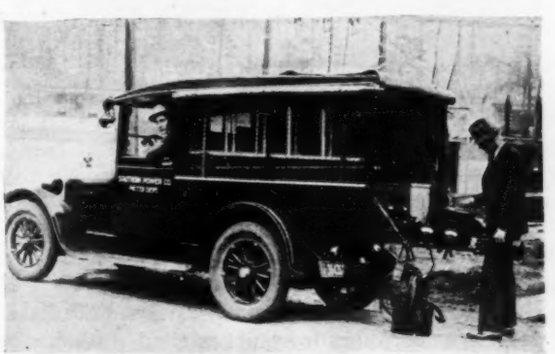
This special adaptation of apparatus was made by the Seattle shops of the Westinghouse Electric & Manufacturing Company under specifications furnished by the writer.

Service Testing of Meter Transformers

How the meter department of the Southern Power Company tests instrument transformers in the field

By B. J. Brown
Superintendent Meter Department, Dubre Power Company, Charlotte, N. C.

TESTING watt-hour meters in service has been reduced to a fine art and work in the field can be done with practically as high an accuracy as in the test room. The great majority of meters will remain accurate for months, even years, but where large blocks of power are measured it is customary to test every few months to find the occasional time that one is not correct and also to satisfy the management that the power is being accurately measured. The testing of instrument transformers in service has not been developed to the same high plane of proficiency. While instrument transform-



Special truck used by Duke Power Company for field test work

The following apparatus is carried on the truck:
Three insulated sticks with heavy insulated leads for connecting the potential transformers to the high side of the circuit.
Two 2,600-volt, 20:1 standard potential transformers.
Two 600-volt, 6:1 standard potential transformers.
Two 500-, 1,000-, 1,200-amp. standard current transformers.
Two 2,500-3,000-amp. standard current transformers.
Secondary lead with snap switches.
One rotating standard.
One indicating voltmeter.
One indicating ammeter.
Rubber gloves.
Slide rule and test block.
Four sections ladder.

Accuracy of Metering Equipment Where Instrument Transformers Are Used

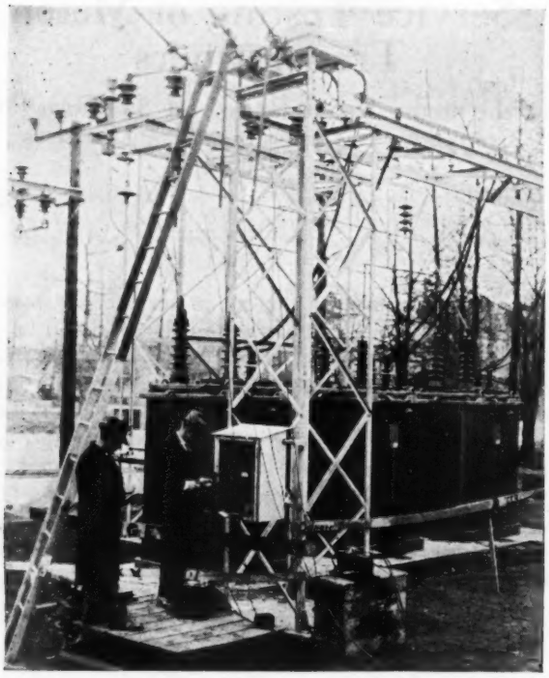
	1924				1925				1926			
Accuracy	Meter and Transformers	Per Cent	Transformer	Per Cent	Meter and Transformers	Per Cent	Transformer	Per Cent	Meter and Transformers	Per Cent	Transformer	Per Cent
0 to 1	184	78.0	207	87.7	205	77.4	210	79.3	208	76.0	241	87.9
1 to 2	39	16.5	20	8.5	50	18.8	48	18.1	50	18.2	30	11.0
2 to 3	11	4.7	8	3.4	6	2.3	3	1.1	12	4.3	1	0.4
3 to 5	1	0.4	0	0.0	0	0.0	1	0.4	3	1.1	2	0.7
Over 5	1	0.4	1	0.4	4	1.5	3*	1.1	1†	0.4	0	0.0
Totals	236	100.0	236	100.0	265	100.0	265	100.0	274	100.0	274	100.0

*These three cases were: (1) One current transformer secondary grounded due to heavy short circuit, 7 per cent slow. (2) Partial ground in secondary cable, 14.1 per cent slow. (3) Partial ground in current transformer secondary, 17.1 per cent slow.

†A550-volt self-contained meter was found 40 per cent fast due to lightning injuring coils.

ers have a high degree of initial accuracy and the majority of them hold it over a considerable length of time, they are exposed to lightning, short circuits and grounds, the heavy artillery of trouble, making it advisable to test frequently under service conditions.

A number of years ago several different sized portable standard current and potential transformers using an indicating polyphase wattmeter were tried out by this company in an endeavor to test and establish corrective



Instrument transformers are tested in the field by the Duke Power Company

constants on complete meter and instrument transformer installations. It was soon found, however, that these tests would not agree under varying conditions and the work was consequently abandoned. It is now realized that the so-called portable standards were built light and had even worse calibration curves than the commercial types upon the lines.

Shortly afterward some German precision type current transformers with hinged joints, designed for slipping over busbars, were obtained. These were checked by the Bureau of Standards for accuracy after opening and closing and subsequently used on special tests over a number of years. Recently the transformers were rechecked by the bureau and found O.K., showing that good hinged type transformers can be built to hold up.

Later, the practice was initiated of removing the transformers and testing them in the meter laboratory. This required a large supply of extra transformers, nearly all of the changes had to be made on Sundays and the installations were so scattered that only a few installations could be changed. With only a limited number of Sundays in a year, this method of testing was far from satisfactory and efforts were directed toward developing a means of testing that could be used to check the transformers while in service any day of the week.

Considering safety and freedom from interruption of prime importance, as many of the customers' circuits were of heavy current rating, and remembering the reliability and accuracy of the German instrument transformers, it was decided to try to secure current transformers that could be slipped over the supply lines. These German transformers were rather heavy and cumbersome and could not be obtained in sizes smaller than 3,000 amp., so the matter was taken up with American manufacturers and very satisfactory units secured which, while possessing rather large ratios and phase angle curves, did not vary nor appear affected by the opening and closing of the gap. The following sizes were tried: 200 amp., 500 amp., 1,000 amp. and 1,200 amp. While the 200-amp. transformer did not prove satisfactory, except for high power factors and when well loaded, the other transformers have been used for several years and tests that have been made on the same meter installations by different individuals check very closely.

The actual metering of customers' circuits is done on the load side of the power transformers. The instrument transformers are usually of the indoor type, mounted in galvanized boxes, and installed on the steelwork of the customer's substation. Conduit is run from the metering transformers to the meter box, located at a convenient spot at the base of the steelwork of the substation or, if of the pole type structure, placed upon one of the poles. The meter is sealed and the box is also locked. A window enables the meter to be read.

The arrangement of the testing apparatus used in checking the accuracy of these installations is shown in the accompanying illustrations. This apparatus consists of the following: Two standard potential and two standard current transformers, voltmeter, ammeter (it is more accurate to calculate power factor) and a polyphase standard integrating watt-hour meter.

The meter is tested first by connecting the polyphase integrating watt-hour meter in series with it on the secondary side of the transformers. This determines the error of the meter under service conditions. Next, a check is made with the standard meter connected. The difference between these two tests gives the combined inaccuracy of current and potential transformers. Then the potentials of the standard meter are changed to the secondary of the service transformers on the test block. The difference between this and the previous check gives the inaccuracy of potential transformers and the difference between this and the first test on the meter gives the inaccuracy of current transformers.

When these instrument transformers show a variation of 1½ per cent from correct they are changed and then retested in the laboratory to determine the trouble. Tests made during the last three years are given in the accompanying table.

A special truck equipped with all the apparatus that is required for any kind of a test has been used in this meter testing work.

In regard to the time and expense of this testing work, costs differ so much throughout the country, due to local conditions, that it is difficult to compare them. On the Duke Power Company system the customers are scattered over a wide area, averaging from 60 to 75 miles from the laboratory, located in Charlotte. On a number of tests reviewed the cost of time and expense per installation averaged $4.50, while the estimated cost of installing tested transformers and taking the replaced transformers back to laboratory and testing was $16.50 per installation.

Ground Resistance Testing

New method of investigation described. Instruments and test procedure outlined. Results of tests and analysis of operation indicated

By W. B. CRAIGMILE
James G. Biddle Company, Philadelphia, Pa.

TESTS of the resistance of ground rods or plates and of grounded structures to earth have been made for many years. All methods of measurement employed in the past have disadvantages, which lack of space here prevents discussing, but which are fairly well understood. However, one objection common to all of these methods is that some calculation is necessary to obtain the result.

Tests by the new method are made with the recently developed "megger" ground resistance tester and require the use of two auxiliary grounds. The resistance of the ground under test is given by the deflection of the pointer on the scale of the instrument in one operation, directly and without any computation. The principle of operation is shown in Fig. 1.

Current is supplied by a self-contained direct-current hand-generator, and after passing through the current coil of the ohmmeter is changed into alternating current for the test by means of a commutator or current reverser. The potential drop across the ground under test

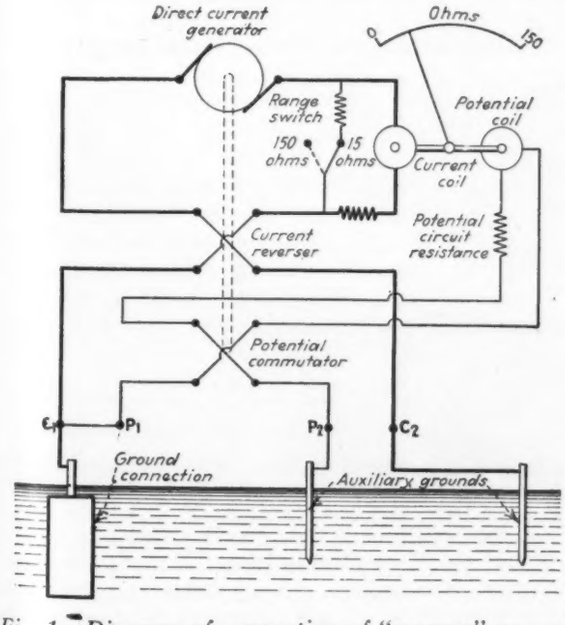


Fig. 1—Diagram of connection of "megger" ground resistance tester

is picked up at P_1 and P_2 and converted into direct current for actuating the potential coil of the ohmmeter. Thus the result is shown at once by the direct-current ohmmeter, having all the advantages of sensitiveness and accuracy of this type.

The two coils of the ohmmeter are mounted on the same shaft and work in opposition in a permanent magnet field. Thus the instrument is a true ohmmeter and indicates R as a ratio of $\frac{E}{I}$, unaffected by the exact voltage generated in the armature, or strength of the mag

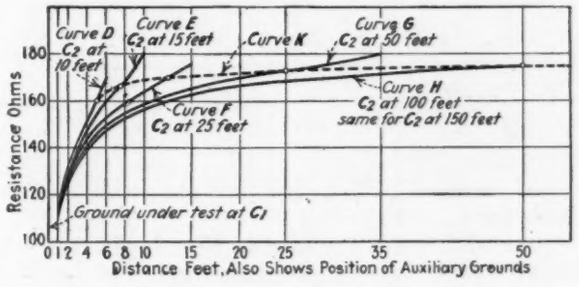

Curve D C2 at 10 feet
Curve E C2 at 15 feet
Curve K
Curve G C2 at 50 feet
Curve H C2 at 100 feet same for C2 at 150 feet
Curve F C2 at 25 feet
Ground under test at C1
Resistance Ohms
180
160
140
120
100
0 1 2 4 6 8 10 15 20 25 35 50
Distance Feet, Also Shows Position of Auxiliary Grounds

Fig. 2—Results of ground tests

Variation of resistance with spacing $C_1 - C_2$. Ground under test at zero feet. Current return ground at 10, 15, 25, 50, 100 and 150 feet. Resistance measured at several points between $C_1 - C_2$.

netic field. The current reverser and potential commutator are on the same shaft as the armature of the generator and so run in synchronism, whatever the speed.

As the current in the ground circuit is alternating, errors due to stray currents—either direct or alternating—in the earth are avoided. At normal speed of turning the handcrank the frequency of the test current is 50 cycles per second. Should there be stray current in the earth of the same frequency as the test current the pointer becomes unsteady. The remedy is very simple—turn the crank slower or faster so as to make the frequencies of the test current and stray current differ from each other.

The resistance to earth of the auxiliary current ground C_2 does not at all affect the accuracy of the test; it can make no difference except in the sensitiveness of the ohmmeter. Tests show that even if the resistance at C_2 is several times the range of the instrument the ohmmeter remains amply sensitive.

The potential circuit of the ohmmeter is of high resistance so as to minimize the effect of the resistance to earth of the auxiliary potential ground P_2. In all but the lowest range of the instrument the potential circuit has a resistance of a least 10,000 ohms; thus a wide variation in the resistance of the auxiliary potential ground is permissible without causing any serious error in the indications. The instrument is compact and of convenient form and weight to be carried easily from place to place.

In most cases the resistance of a water pipe to earth will be found to be small. Where considerable resist-

ance exists it is usually due to joints made with some poor-conducting material. The resistance of a ground connection referred to a water pipe can be measured directly by the "megger" ground resistance tester. It is necessary only to join C_1 P_1 (Fig. 1) to the ground under test and C_2 P_2 to the water pipe. If the resistance of the water pipe to earth is suspected to be more than a few tenths of an ohm it can be tested in the usual

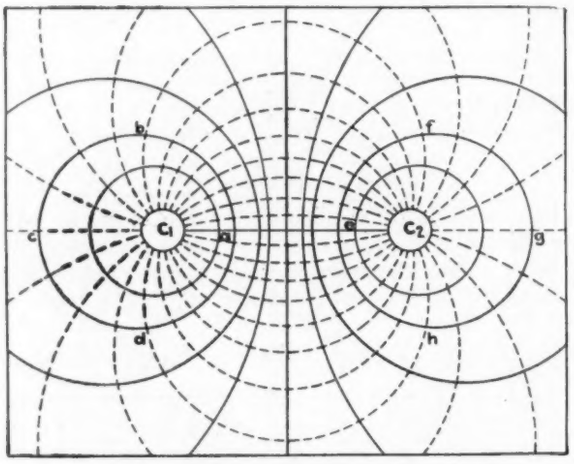


Fig. 3—Current and equipotential lines between two electrodes near the surface of the ground

manner, joining C_1 P_1 to the pipe and using auxiliary grounds for C_2 and P_2.

Results of a test are plotted in Fig. 2. In this test a series of stakes made of ¾-in. galvanized iron pipe were driven 3 ft. into moist, sandy loam. Stakes were driven at 0, 1, 2, 4, 6, 8, 10, 15, 20, 25, 35, 50, 65, 100 and 150 ft. The resistance to earth of the stake at 0 ft. (C_1 of Fig. 1) was determined to be 175 ohms. Repeated measurements of this resistance and the distribution of resistance were made for spacings C_1 — C_2 of 10, 15, 25, 50, 100 and 150 ft. respectively.

The curve for a spacing of 150 ft. C_1 — C_2 is coincident with curve H for 100-ft. spacing within the probable limits of observation. Curve K, shown dotted, is drawn through the mid-point values of the other curves.

It will be noticed that for spacings of C_1 — C_2 of 10, 15 and 25 ft. the midpoint readings are correct within an error not exceeding 10 per cent. However, the slope of the curves at their mid-points is quite steep, so that a slight misplacement of the potential stake may result in a considerable change in the reading. Also for close spacing we must bear in mind that if the resistances to earth at C_1 and C_2 are not nearly equal in value the curves will be distorted and the reading at the mid-point may not give a true idea of the actual resistance of the ground under test.

From curve G for a spacing of C_1 — C_2 of 50 ft. the difficulties mentioned can be seen to be much reduced, and for spacing of 100 and 150 ft. C_1 — C_2, curve H shows that the difficulty appears practically not at all. Therefore, it seems safe to say that the auxiliary ground for current return, C_2, should be at least 100 ft. from the ground under test, C_1, and the auxiliary potential ground approximately 50 ft. from the ground under test. For commercial accuracy the distances may be reduced to 50 ft. and 25 ft. respectively. The curves shown are typical of many obtained and will serve as examples.

Let C_1 and C_2 of Fig. 3 be two electrodes near the surface and carrying into and out of the earth. If the electrodes are not large compared to the distance between them, and the surrounding earth is of uniform quality, the current distribution and equipotential lines at the surface of the earth will have the general form shown in the figure. The dotted lines represent current flow and the solid lines represent equal potentials, although no attempt has been made to draw them to scale.

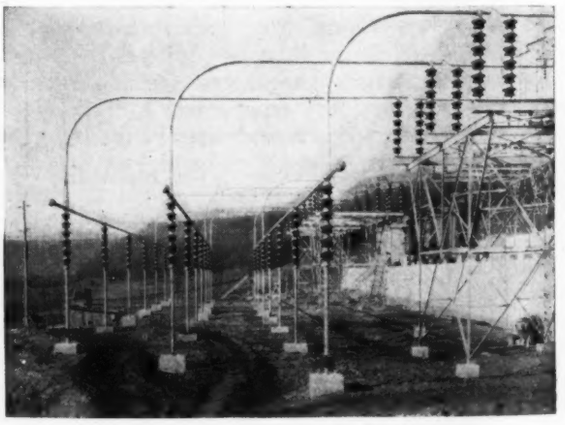
The curves, Fig. 2, show that for proper spacing of C_1 — C_2 to measure ground resistance the electrodes will usually be relatively small and relatively near the surface of the earth; therefore we need consider only the distribution as in Fig. 3, at the surface of the earth. If we measure the flow of current into the earth and the potential from C_1 to point a we can obtain a value of resistance. A measurement to any point on the line a, b, c, d will give the same value. Therefore the equipotential lines become lines of equal resistance.

Suppose that C_1 and C_2 are far enough apart so that a measurement of resistance on the line joining them and taken anywhere between a and e gives a resulting value of a sufficient degree of accuracy. (See Fig. 2, curve H.) Then a measurement on any equipotential line passing between a and e will give an equally good result.

Heretofore we have assumed that in measuring resistance by the single-test "megger" method (or the a.c. fall of potential method) points C_1, C_2 and P_2 should be in a straight line. We now see this is not necessary; P_2 can be placed anywhere except within two relatively small restricted areas, *abcd* and *efgh*. Thus P_2 may be placed far to one side of the line joining C_1 and C_2 or back of C_1 or C_2.

In conclusion, it is important to note that all that has been said regarding the spacing of auxiliary ground connections applies to any of the various methods in common use for measuring ground resistance.

Simplified Bus Design at Siegfried



THE bus structure at the new Siegfried (Pa.) substation of the Pennsylvania Power & Light Company is constructed of 5-in. steel tubing welded together. The portion indicated in the accompanying illustration is that serving to connect the circuit breakers to the 220,000-volt line. The unusual design of bus supports presents an illusive impression of the real proportions. Note workman at right. Siegfried will serve as a tie-station in the 220,000-volt, 200-mile transmission ring connecting the systems of the Philadelphia Electric Company, the Pennsylvania Power & Light Company and the Public Service Electric & Gas Company.

Carrier-Current Control
for Street Lighting

San Francisco has one of first installations. System eliminates substation street lighting feeders and control apparatus. Transformers installed near load center

By R. Roy Cowles

Assistant Engineer Department of Engineering
Pacific Gas & Electric Company, San Francisco, Cal.

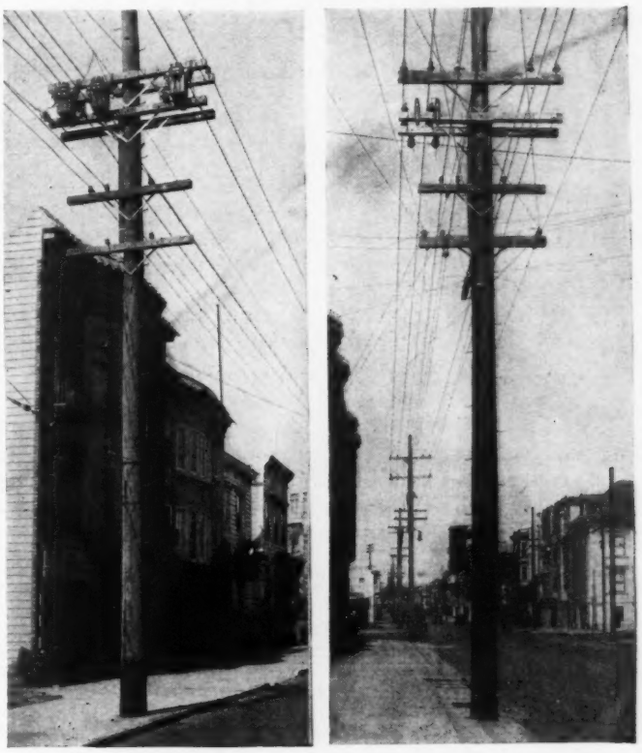
VACUUM tubes and the principles of radio communication which are being utilized by power companies for communication over transmission lines and for remote signaling and relaying are now entering the field of street-lighting control. Although the remote control of street-lighting circuits by carrier current has been under development for more than four years and has been watched with interest by utility engineers, one of the first commercial installations ever made has just been completed in San Francisco by the Pacific Gas & Electric Company.

The system consists essentially of a transmitting set in the substation and a receiving set centrally located with respect to the circuits to be controlled. The carrier-current equipment operates over one phase of a three-phase, 4,000-volt feeder through capacitor couplers in the substation and out on the line. In the substation there is a control transmitter connected to a line tuning unit, the latter being connected to the phase wires through fuses and capacitors on the line side of the feeder voltage regulators. The receiving set is located on a pole approximately 5,000 ft. from the substation and consists of a control receiver connected to the same two-phase wires through fuses and capacitors. A 600-watt, 2,300/115-volt transformer on the same pole supplies 115 volts for the operation of the receiving control circuit. Three single-pole, 2,300-volt oil switches are mounted on a pole one span away to avoid congestion. These energize the street-lighting transformers from the 4,000-volt feeder. Two No. 6 wires are run between the control receiver and the oil switches for operation of the latter.

The oil switches are connected through inclosed type cutouts to the individual phase wires of the feeder. Three separate phases are run from the oil switches in different directions to supply the various constant-current regulating transformers located in the vicinity. There are at present nine 20-kw. transformers operating from the control. Connections for the apparatus involved in carrier-current street-lighting control are shown schematically in the accompanying diagram.

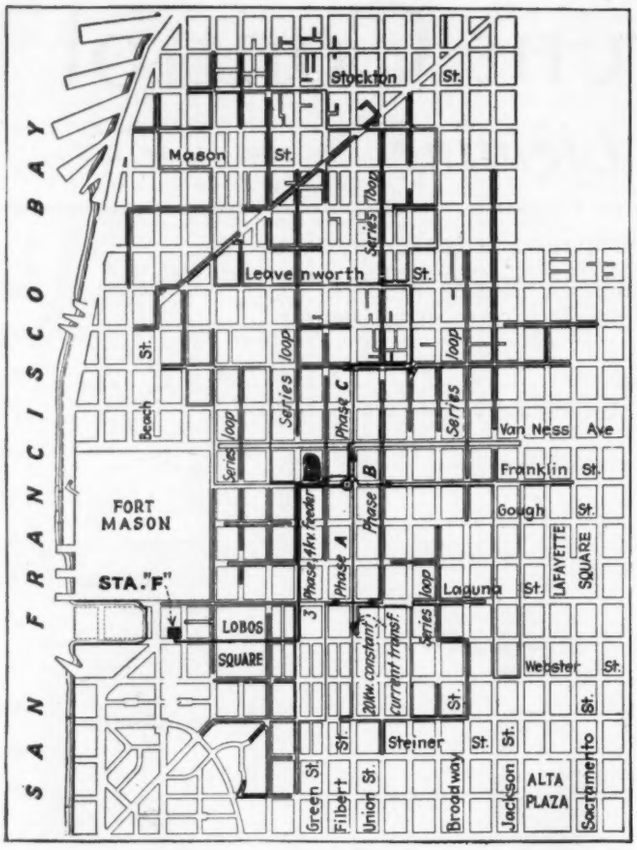
The transmitting circuit used is a Colpitts oscillating circuit using the full wave self-rectifying principle. The transmitter is rated at 100 watts, using two 50-watt tubes, one operating on each half of the supply voltage cycle. It delivers 2.5-amp. radio frequency into the 4,000-volt feeder. Filament and plate voltages are supplied from a power transformer. During one-half of the supply voltage cycle the voltage impressed on one of the tubes is positive and on the other negative. The tube using the positive voltage oscillates, while the other tube stays idle due to the negative voltage impressed upon it. Across the oscillating circuit is the primary of the output transformer, the secondary being coupled to the outgoing feeder by means of the line tuning unit and coupling capacitors.

The transmitter is adjustable to three frequencies, 35, 40 or 45 kilocycles. This is far below the broadcast frequency band of 550 to 1,500 kilocycles and has caused no interference with radio broadcast reception. The transmitter is adjusted to 35 kilocycles, which was found by test to be the most efficient frequency for the particular



Three 2,300-volt, pole-mounted oil switches operated by control receiver in weatherproof box on pole at right

In the view at the left fused cutouts are on the opposite side of the pole. In the illustration at right the 4,000-volt feeder is shown on the top cross-arm, below which are the fuses and line connecting capacitors.



Territory included in carrier-current street-lighting control

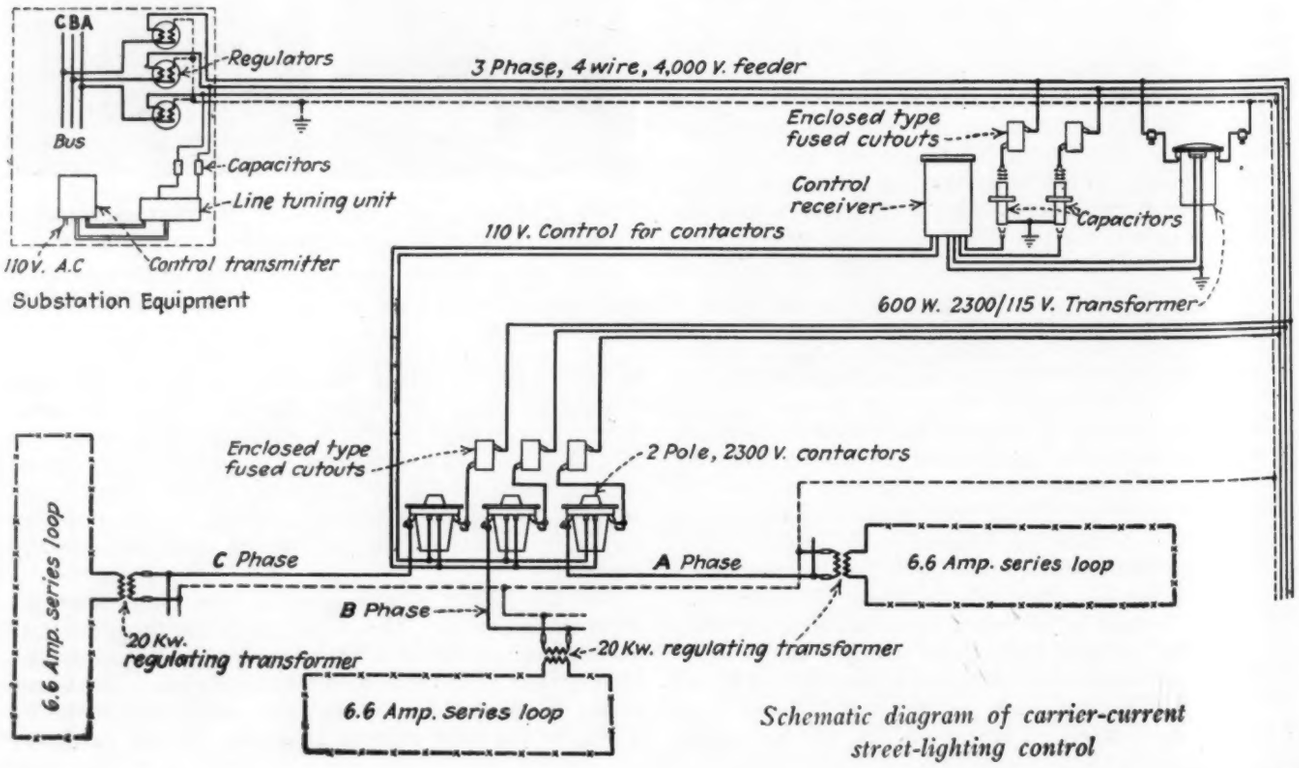
feeder circuit used. By long or short time intervals during which the transmitter operates the same frequency is made to serve for both turning the lights on and off. The time interval for closing is four seconds and for opening fourteen seconds.

The receiver is a simple biased detector circuit using one UX-210 tube. Filament and plate voltages are obtained from a small transformer. The tube is always energized, but the grid is so biased with alternating current that no current flows in the plate circuit until a voltage is impressed on the receiver input. The plate current output of the tube is 3.5 milliamp. although the polarized relay which it actuates will operate on as low as 0.8 milliamp. The plate current energizes a polarized relay, which in turn energizes a time selector relay operating at 120 volts a.c. This relay closes after an interval of four seconds and opens after an interval of seven seconds and operates the control contactor, which in turn controls the oil circuit breakers on the street-lighting circuits. Push-button control is provided so that the time selector relay may be closed manually if desired.

Before turning the equipment over for operation, tests were made by the engineering department to determine certain features. It was found that: (1) Street lights can be turned off immediately after being turned on, but cannot be turned on again until the selector relay in the receiving set has reset itself, its time interval being 45 seconds. (2) When street lights are on loss of voltage will cut lights out, but they will come on again when voltage is restored. No adjustments need be made at the transmitter.

Flexibility of System

This control system as now installed at Station F can be expanded considerably with the addition of minor equipment only. At present one transmitting set operates one receiving set controlling approximately 3 square miles of street-lighting area operating on the same time schedule. The transmitter panel is equipped for three control circuits, making it possible to provide control for two more 4,000-volt feeders by simply adding a line tuning unit and two capacitors to each feeder controlled and by installing the necessary control receivers and capacitors at convenient points out on the line. With



Schematic diagram of carrier-current street-lighting control

the present installation the oil circuit breakers can handle three times the present street-lighting load, or the phase wires can be extended to provide for new areas.

The center of load for the street lighting in the present control area is approximately 5,000 ft. from the substation, but the range of the equipment is greatly in excess of this distance. The polarized relay of the receiver will operate on 0.8 milliamp., as previously mentioned, although it is now receiving 3.4 milliamp. Thus the receiver would still operate successfully if it were moved to a point several miles distant from the substation. Since a receiver draws virtually no radio-frequency current from the feeder it is possible to connect a large number of receivers to a feeder without reducing the control radius of the station transmitter. In addition to this fact the number of feeders to which one transmitter can be connected is limited only by the number of feeders radiating from a single substation. Hence the area that can be controlled by one transmitter is dependent upon the distribution feeder system rather than any limitations of the carrier-control system.

Advantages of System

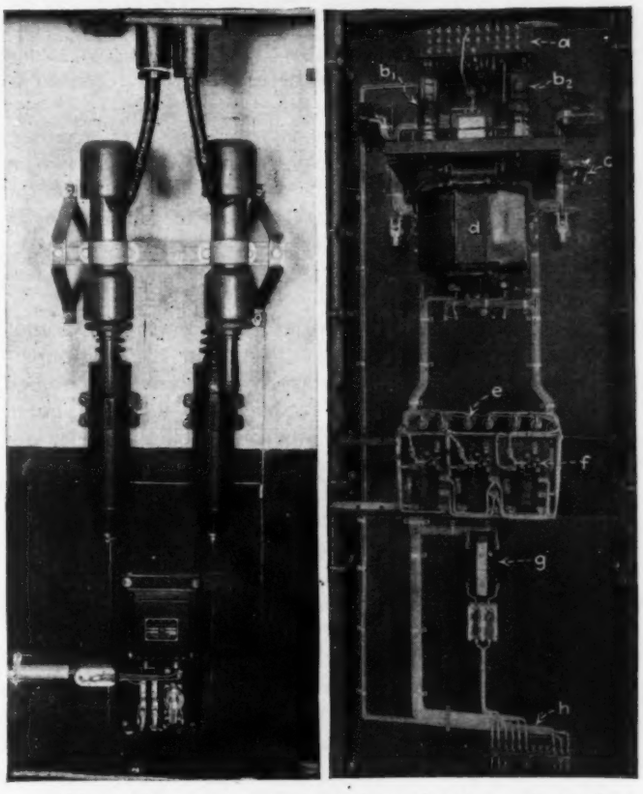
Carrier-current control makes possible the use of the multiple-feeder system of street lighting, which is more reliable and subject to less trouble than straight series systems fed from the substation. Elimination of the constant-current transformers from substations has made possible economy of space and reduced cost and avoids the excessively long series loops, with consequent high voltage, which have been a source of trouble and frequent interruption in the past.

The disadvantage of the multiple-feeder system is its cost and the resulting congestion of poles and underground conduits in the vicinity of the substations. Carrier-current control makes possible the elimination of that portion of the feeders from the substation to the point of control, also substation switching equipment, etc. This represents a large percentage of the cost of the street-lighting system. Carrier-current control of street lighting fed from commercial feeders permits taking advantage of the diversity between commercial load and street-lighting load, thus utilizing feeder copper and substation facilities at greater efficiency.

Pilot wire or some similar form of wired control might in certain favorable cases be used instead of carrier current to accomplish the same purpose. The congestion of poles and underground conduits in the vicinity of the substation as well as the cost would, however, in most cases eliminate such systems from consideration. Moreover, pilot wire control must of necessity be limited to very short distances, while carrier-current control has no such limitation.

A brief historical review of the street-lighting practice of the Pacific Gas & Electric Company and the considerations leading up to the use of carrier-current control may be of interest. A large percentage of street lighting on the system of this utility had been supplied from constant-current transformers installed in the substations. As cities grew and demand for street lighting increased, series circuits were expanded by adding more wire, increasing the number of lamps per circuit and including more territory in a single loop. In many cases it was necessary to take new series circuits out of the substations as the constant-current transformers were becoming overloaded. Many of the constant-current transformers were of 70-kw. capacity, operating at 7.5 amp., which made the normal voltage approximately 10,000 volts. In case of an open circuit, the voltage would rise considerably above this value. As these series circuits grew they eventually reached extreme lengths, one circuit in Oakland being more than 60 miles long. As a result of the extreme lengths of these series circuits and the consequent high voltage they were subject to considerable trouble.

It was therefore apparent that changes must be made



Line tuning unit and rear of carrier control panel

Tuning unit is connected to 4,000-volt feeder in substation through tetrachloride fuses and capacitators.

The control panel is equipped for the control of three separate feeders. Flexibility of carrier current street-lighting control permits the operation of midnight lights or other schedules if desired.

(*a*) Output transformer. (*b*1, *b*2) Two vacuum tubes. (*c*) Test key. (*d*) Power transformer. (*e*) Red and green lights indicating "on" and "off." (*f*) Position relay—suitable for three-circuit controls. (*g*) Line switch—110-volt a.c. from supply circuit. (*h*) Terminal block for connections.

in the street-lighting system to reduce the number of interruptions and consequently improve the service. Analysis has shown that for the territory involved a series incandescent lamp system was more economical than a multiple system. It was readily apparent that if series street lighting was to be used the number of miles in each circuit must be materially reduced, and similarly the voltage and the number of lamps per circuit. The space occupied by the constant-current transformers in the substations was also of considerable importance, and as the substations became crowded, or as new substations were built, this space became increasingly valuable. Two considerations, therefore, became of great importance, the removal of constant-current transformers from substations and reduction in length and voltage of series circuits. These considerations led to the adoption of the following street-lighting principle, which was put into effect about five years ago:

Constant-current transformers, all of 6.6 amp. secondary, to be installed on the pole or in the manhole at the most convenient locations.

Size of constant-current transformers to depend upon

the average size of lamps. Since the average number of lamps per circuit is 60, it works out that the most economical size for San Francisco division is 20 kw. and for the other divisions 10 kw. This arrangement keeps the voltage on the series circuit down to 3,000 in San Francisco and 1,500 in the other divisions.

The constant-current transformers are fed by 4,000-volt, three-phase, four-wire multiple feeders, which are switched at the substation and treated exactly as any other distribution feeder with the exception that there are no feeder regulators. Where lights are required to be switched on different schedules, such as all night and midnight, one of the phases is used for that schedule, whereas the other phase may be used for other time schedules. Where all of the street lighting is on the same schedule, the three phases are run out as single-phase feeders to supply different areas. In a few cases the principle of "cascading" is followed, whereby a series circuit will operate the series coil of a 2,300-volt oil switch, which in turn provides excitation for another series circuit through a constant-current transformer.

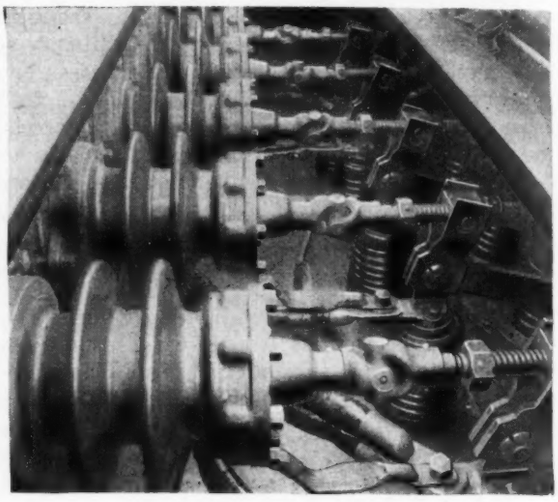
Experience with multiple electrolier circuits supplied by 4,000-volt, three-phase feeders had already shown that the same degree of reliability which had been obtained from distribution feeders of the same type and voltage could be expected from such street-lighting feeders. By shortening the length of the series loops and reducing the voltage it has been possible to reduce greatly the number of interruptions and improve the service, and by removing the constant-current transformers from the substations much valuable space has been saved and capital investment reduced.

At the time the above general plan was adopted engineers of the company were considering other types of control whereby distribution feeders could be utilized in their existing form and constant-current transformers installed on poles or in manholes. At that time consideration was being given to oil switches operated by some type of pilot wire, or carrier-current control over the 4,000-volt distribution feeders. The latter method was favored, but it was not until early in 1927 that the company felt that carrier-current control had progressed to the point where it could be regarded as reliable. One complete control unit was installed during the summer of 1927, and has functioned successfully since that time.

Transformer Disconnecting Switches in Oil-Filled Potheads

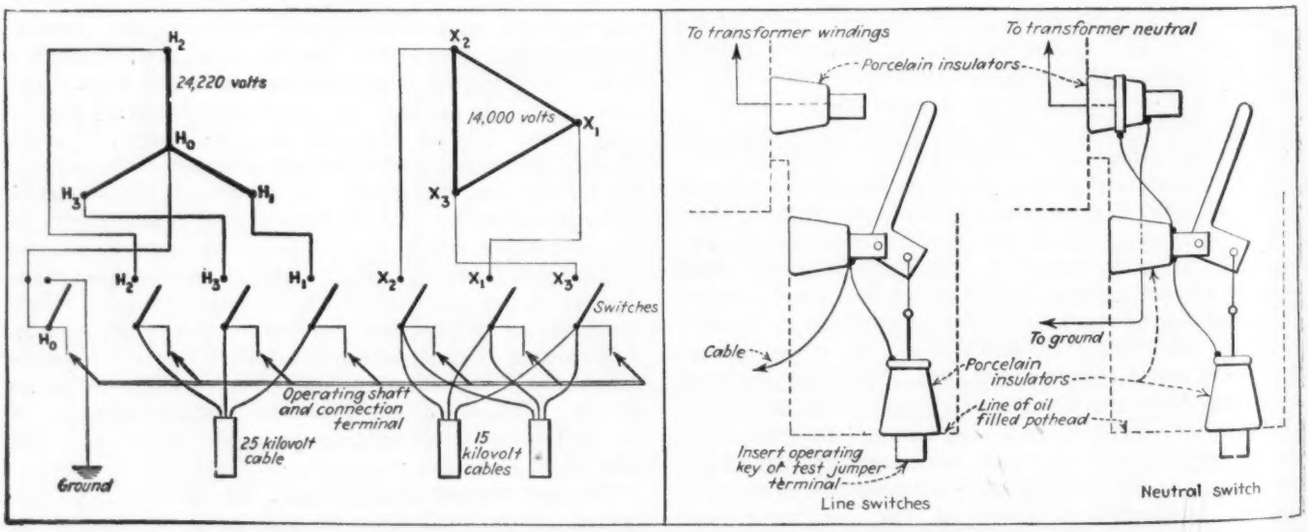
By Wellen H. Colburn
Edison Electric Illuminating Company of Boston

REFERENCE was made by the writer in a recent article (Electrical World, Oct. 22, 1927, pages 845 to 847) to special disconnecting facilities installed in oil-filled potheads on transformers of the Boston Edison Company. The accompanying illustrations show the scheme in more detail than was presented in the original article.



Interior of oil-filled pothead showing bushings and switch-operating shafts

The above illustration of one of these potheads shows the arrangement of insulating bushings and switch-operating mechanism in a field installation. The four bushings and associated operating shafts at the top of the illustration are on the 24-kv. connections of the transformer and the two at the bottom, with a third which cannot be seen, are on the 15-kv. connections.



Connections between transformer windings and pothead switches. Details of cable ground and jumper terminals shown at right

Switching is effected by an insulated operating key, not shown in the accompanying halftone. The handle permits external operation.

The bushings at the left are hollow and contain the "bayonet" end of the switch-operating mechanism, into which the key fits and to which the jumper connections are made as shown in the connection diagrams. All the porcelain will withstand over 100 kv. as installed to allow kenotron tests to be applied to the cables. The arrangement shown for the neutral switch permits the disconnection of the transformer neutral from the ground and the application of a "high-potential or other test to the transformer windings, should advance in the company's testing program or the experience of the industry justify it." Testing of transmission cables is accomplished by opening the switches and connecting the high-potential test jumpers to the bayonets.

Attracting New Industries by Utility Company Aid

VIGOROUS activity is under way in New England utility circles in the field of industrial development through central station co-operation with the New England Council, chambers of commerce and other organizations. The co-operating power committee of the electric service companies, headed by C. L. Edgar, has appointed a committee on industrial development under the chairmanship of Julius Daniels, assistant superintendent sales department, Boston Edison Company, which is rapidly becoming a factor in territorial industrial surveys and movements toward increasing such development. The other members of this committee are R. D. Morrison, industrial engineer Central Maine Power Company; A. R. Schiller, vice-president Public Service Company of New Hampshire; E. C. Hathaway, Twin State Gas & Electric Company, Boston (representing Vermont); P. J. Wilson, sales manager Narragansett Electric Company, Providence, R. I., and A. V. S. Lindsley, sales manager Connecticut Light & Power Company, Waterbury, Conn.

A number of New England power companies have established industrial development bureaus in their organizations and outlines for making industrial inventories have been sent to each company. Survey work is proceeding, contacts with chambers of commerce, co-operation with real estate agencies and railroads are being made, local business organizations are in many cases being advised of all bids sought by the United States government, air mail letters are being sent to prospective industrial concerns and advertising is being carried in trade papers emphasizing the power facilities of the territory. This work is in many cases being tied in with that of the power sales departments of the utilities, and at a recent meeting of the New England Association of Central Station Power Sales Engineers at Boston Chairman Daniels described the above industrial promotion work in considerable detail. The outline of an industrial survey sent to territorial operating companies includes eleven pages of form sheets.

Electrolytic Production of Oxygen Proves Economical

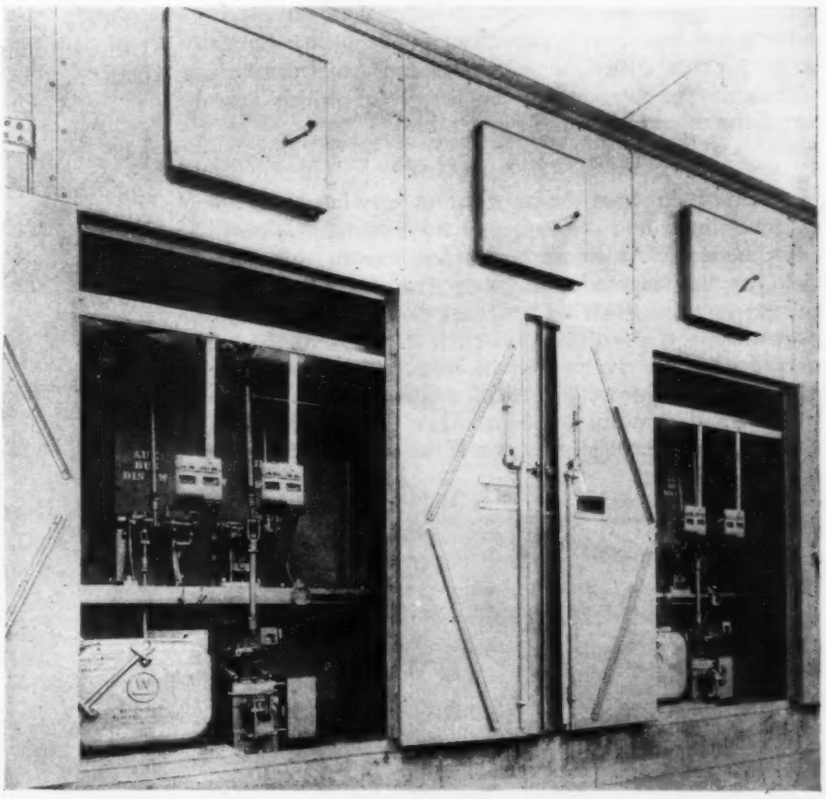
General Electric Company

Comparative Data for 1,000-Cu.Ft.-per-Hour Oxygen Plant	Liquefaction Process	Electrolytic Process
Oxygen produced per kilowatt-hour (theoretical)	25 cu.ft.	5.29 cu.ft.
Oxygen produced per kilowatt-hour (actual)	24 cu.ft.	4.00 cu.ft.
Initial cost for producing equipment	$25,000	$50,000
Non-productive time required to get plant into full production	2 to 8 hours	Almost instantly†
Number of hours per day plant must run to be most economical	24	Depends on type of cell
Rate of depreciation, per cent	10	10
Byproducts produced (theoretical)	100 cu.ft. N_2	10.58 cu.ft. H_2
Byproducts produced (actual)	88 cu.ft. N_2	8.00 cu.ft. H_2
Equipment area required, including aisles, etc.	800 sq.ft.	2,500 sq.ft.‡
Ratio of labor cost per 1,000 cu.ft., per cent	100	100
Relative incidental material costs per 1,000 cu.ft., per cent	100	90
Relative maintenance costs per 1,000 cu.ft., per cent	100	90
Purity of oxygen, per cent	99.0	99.5
Purity of byproduct, per cent	99.0 N_2	99.5 H_2
Connected load for production only	55 hp. approx.	330 hp. approx.
Ratio of other costs per 1,000 cu.ft., per cent	100	100

† A short time, together with an increased power consumption, is necessary to bring the electrolyte to normal operating temperature.

‡ Includes area for motor-generator sets. This varies with the type of cell, but a sacrifice in operating efficiency results if floor space is favored at the expense of other design features of the cell.

Outdoor Cabinets Used for Station Extension



EXISTING indoor switching equipment was amplified by outdoor additions at the Northwest station of the Commonwealth Edison Company, Chicago, Ill. The 12,000-volt buses and disconnecting switches are within the upper doors. Wheel-mounted circuit breakers and their operating mechanism are mounted below. Phase segregations on 50-ft. spacings are used.

Exporter Reviews South American Market

Large field calls for same selling methods as used in domestic market. American capital needed in South America's public utilities

By McKew Parr
President Parr Electric Export Corporation

VIRTUALLY all American electrical appliances may be sold in the South American market provided the same intelligence, patience and courage are displayed as are exercised in selling the same material in the domestic market. The greatest handicap to the development of the American electrical export business is the lack of familiarity and personal interest in these export markets by the directing heads of the smaller electrical companies. When the executives of the American electrical manufacturing companies show the same personal interest in foreign markets that is displayed by the German manufacturers, then, indeed, the future for the American electric export business will be very bright.

The standard practice of the lighting companies in South America is modeled after the practice of their home countries, most of their purchases being made in the country where the control of the stock is held and from which most of their engineers come. It is for this reason that all American electrical manufacturers are observing with sympathy and interest the activity of one of the large holding companies in the United States which has acquired a number of central-station properties in the smaller cities of South America, particularly in Brazil. When an American holding company secures an interest in a South American public utility company it means that American engineers and American wiring standards are introduced, the benefit of which accrues to all the manufacturers in general.

Competition Is Chiefly National

In South America the competition very largely is along national lines, and consequently there should be no jealousy between American manufacturers in the foreign field, as the success of any one manufacturer in introducing American wiring practices results in a better opportunity for all other American manufacturers. No matter what the rivalry may be between companies in the United States, every American electrical man abroad is pleased and grateful to see another American electrical manufacturer secure business and advance American wiring practices.

A great source of help to the American electrical manufacturer visiting the South American market is found in the offices of the commercial attachés of the Department of Commerce, who are extremely accommodating and helpful to the salesmen of American manufacturers, their advice and information being of great practical value. Inasmuch as the steamship companies and cable companies of other nationalities all very properly do what they can to help the manufacturers of their own countries, American manufacturers should support similar services that have been built up by American capital.

It is very gratifying to observe the high estimate placed in South America upon the quality and dependability of American electrical material. The prices of American electrical materials are considerably higher than those of European manufacture, but it is my observation that in all cases it was felt that American electrical materials and practices were of the very best and, despite the much higher price, it appears to be the general opinion that the American product was worth the increased charge. It is my opinion that, despite the price handicap, our goods may be sold in all markets in very large volume by applying to their sale the same methods of missionary work and advertising that have been developed in marketing similar products in this country.

It is essential, in order to reap the greatest benefit from the possibilities that are open to American manufacturers in South America, that this country invest more freely in the securities of South America's public utilities. A study of the returns to stockholders in the United States who have invested in South American utilities proves that the field offers a very attractive return on the investment, with a high rate of security provided the management is trustworthy. By applying the experience and efficiency that we have gained in the operation of central-station business in this country we cannot help but meet with considerable success in South America.

Recommends U. S. Investment in South America

It was the unanimous opinion of all Americans in South America with whom this subject was discussed that it would be very much more beneficial for the future of the United States to invest its capital in the utilities in Brazil and the Argentine Republic, Chile and Peru, instead of lending its capital, as at present, to the European financial agencies that support the manufacture and exportation of European electrical material to South America. It was the opinion of those consulted that the United States is simply lending its own gold to its competitors to use against us in this market.

The German electrical manufacturers have shown a great deal of interest in the South American market and have many branches, carrying large stocks, in all the important centers. In general, the German products are considered to be decidedly inferior to the American goods, although they are usable and workable. There are very few British electrical lines of wiring supplies to be found in South America with the possible exception of power cables. There is one Belgian manufacturer of motors, control apparatus and wire that has a very good business in Brazil. An Italian manufacturer of motors and of fans and another Italian maker of wires have branches throughout the various countries and do an excellent business. An Italian manufacturer of electric-heating appliances has a small sale in Brazil. The Italian interest in the electrical industry is very active throughout South America, many of the leading jobbers and contractors being Italian and several important central stations are of Italian ownership. A well-known Dutch manufacturer of lamps has an extremely large business, a Dutch manufacturer of wire has a fair business, and a French manufacturer of wire has a small business, mostly of annunciator and office wire. Electrical fixtures are manufactured both in Brazil and in the Argentine Republic by local firms which do a considerable business. There are two wire manufacturers in Brazil, both appearing to be prosperous.

In these countries there is a great lack of capital and an appreciation on the part of the educated classes of the necessity for development of the public utilities by

American or European capital. In Brazil the legal rate of interest is 12 per cent per annum, but the average merchant and business man have to pay considerably more. One can secure on time deposits in Brazil from the leading banks an interest rate of 9 per cent per annum, so it will be seen that the country offers a most excellent field for investment.

Merchandising Methods of Berlin Electrical Company

PROGRESSIVE merchandising methods are not confined to the United States. In Berlin the Berliner Städtische Elektricitäts Werke Aktien Gesellschaft makes use of elaborate display rooms, newspaper advertising, illuminated dwelling houses, illuminated signs and catchy poster effects on the monthly bills. The influence of the latter was measurable by the large number of inquiries that came each month for the particular appliance then advertised. These appliances included sewing machine motors and sewing lamps, hot water accumulators, washing machines and vacuum cleaners. The same method was used for special publicity on the deferred-payment plan. In addition, a model of the company's new 300,000-kva. power plant was displayed at three exhibits held by various outside organizations during the past year.

To facilitate the wiring of homes and the purchase of appliances, the company made arrangements with a large number of contractors and dealers for financing the customers' orders.

For this purpose a separate organization was established. The customer pays a certain percentage down and signs an agreement with the company to pay the balance at the same time he pays his lighting bill. To cover overhead and interest a charge of 5 per cent is made for payments in five monthly installments or 10 per cent for ten months. Meanwhile, the company advances to the contractor or dealer the unpaid balance. The customer, of course, has the use of his purchase during the period of payment. With the traditions prevailing in Germany this is a radical innovation.

The company states that the plan is meeting with increasing favor and has found particular application for Christmas purchases. To assure the purchase only of articles coming up to accepted standards, the company maintains a testing laboratory. This is apparently in lieu of a nationally functioning organization for approving equipment and installations. The company also exercises supervision over the contractors, through a system of approvals which can be and in a number of cases have been withdrawn for cause. At the end of 1926 there were 2,850 approved contractors or contracting firms.

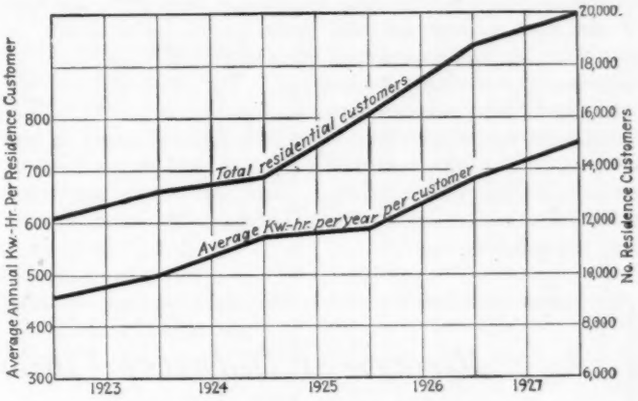
The company's progressive policy evidently pays. During 1926 the number of low-tension customers (presumably residential, commercial lighting and small power) increased from 368,706 to 442,044, a gain of almost 20 per cent. During the same period the corresponding connected load increased from 516,915 kw. to 555,698 kw. and the total connected load from 741,417 kw. to 801,203 kw.

Residential Customers Use 753 Kw.-Hr. per Year

By D. F. McCurrach

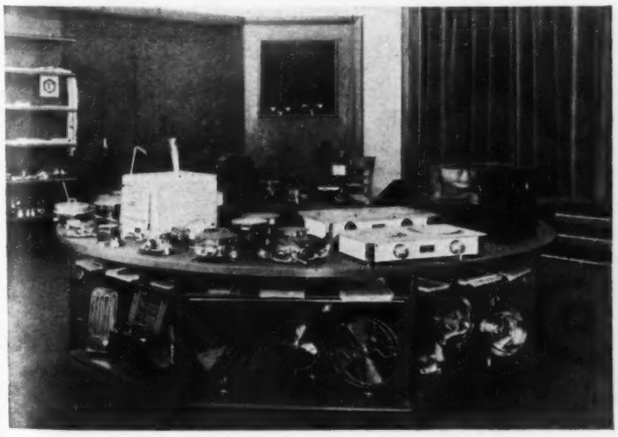
Rate Engineer Northwestern Electric Company, Portland, Ore.

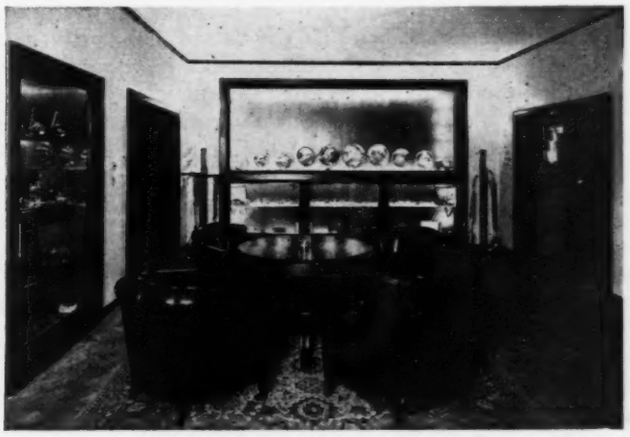
EXCLUSIVE of electric water heating, residential customers on the system of the Northwestern Electric Company, Portland, Ore., used an average of 753 kw.-hr. each during 1927. If water heating is included



Range sales contribute to increasing domestic consumption

the consumption was 946 kw.-hr. per customer. The number of residential customers and the average annual consumption per customer for the past five years are shown by the accompanying curves. This system embraces a considerable rural territory in southwestern Washington, which has a tendency to lower the average. The effect of adding a large number of rural customers





Readily accessible appliance display stand and customers' lounge room also having equipment on display

PRIMARY RATE FOR RESIDENCE LIGHTING COVERING FIRST 100 HOURS USE OF DEMAND

75 per cent of customers pay for first 20 kw.-hr. at primary rate and balance at secondary rate.

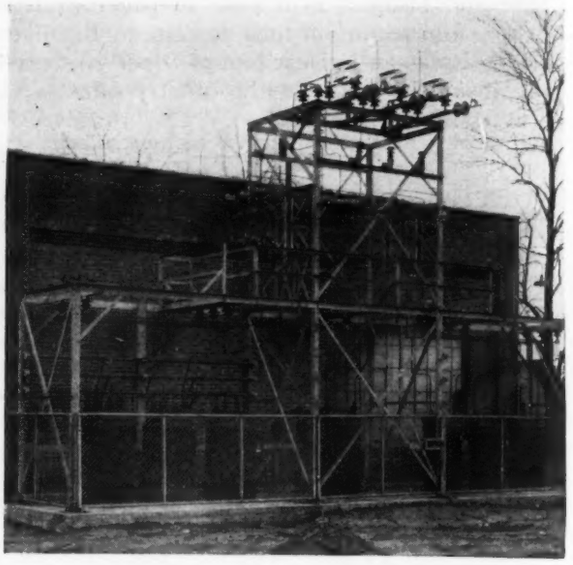
	Cents Per Kw.-Hr.
First 9 kw.-hr. per month	8
Next 70 kw.-hr. per month	7
Next 100 kw.-hr. per month	6
Excess over 179 kw.-hr. per month	5
Secondary rate:	
First 50 kw.-hr. per month	3
All excess per month	2

A discount of 5 per cent allowed for prompt payment.
Minimum charge for lighting service only $1 per month.
Minimum charge for lighting service in combination with heating, cooking and small domestic power loads in excess of 2 kw. connected, $2 per month.

in 1925 is clearly shown by a rise in the customer curve and a drop in the consumption curve.

The gratifying increase shown in domestic consumption over the past five-year period is of particular interest in view of the fact that during this time the rates have not been changed and the showing made would seem to be an indication of their reasonableness, as the customer has seen fit to utilize this service in increasing quantities. Obviously, this would not have been the case if the cost of service had been found burdensome in any way, or had it represented a large percentage of the expense of maintaining his home. The principal element contributing to this increase is undoubtedly ranges, the saturation of which has increased from around 5 per cent in 1923 to approximately 20 per cent at the present time. Radio, home-lighting campaigns and appliance sales efforts also have contributed in a large measure to this upbuilding.

A Multi-Voltage Industrial Substation



THIS industrial substation, through which the Fort Wayne, Ind., works of the Western Gas Construction Company, a subsidiary of the Koppers Company, is served by the Indiana Service Corporation, may be taken as a good example of modern construction and design. The incoming power is at 13,800 volts and serves secondary demands of 225 kva. at 4,000 volts, 450 kva. at 460 volts and 100-kva., single-phase for lighting at 115-230 volts. Provision is made in the design for primary metering equipment which has not yet been installed.

Electrical Industry Objects Only to Power Feature of Boulder Dam Bill

An Interview With
R. H. BALLARD
President Southern California Edison Company

"NO PROPOSED legislation in recent years has attracted more attention or has been more involved in politics that the Swing-Johnson bill to provide governmental flood control and power development on the Colorado River. Failure of the bill to pass has been laid partly at the door of the privately operated utilities of the nation and partly to opposition of the basin states, notably Arizona. It is the proposal to put the government into the power business and the unjust accusation made against the light and power utilities of blocking the bill that concern me and upon which I feel strongly," declared R. H. Ballard, president of the Southern California Edison Company to a representative of the ELECTRICAL WORLD recently.

"One point should be made clear to the ardent supporters of the Boulder Dam bill, and that is that the electrical industry and business interests of the nation oppose on principle all schemes which would put the government into business and do object most emphatically to the provision still retained in the bill authorizing the government to build and operate power plants at Boulder Dam in violation of the policy laid down in the federal water-power act passed by Congress in 1920, after more than ten years of deliberation.

"If the bill should be amended to remove this objection it would still provide the benefits sought for and permit repayment of the cost of the dam to the government. It could also provide that the government construct the dam and that the power development be made under the provisions of the national law and be subject to regulation by the Federal Power Commission. Any agency — municipal or corporate—desiring to develop power at the dam could then apply to the Federal Power Commission for a license to do so. Moreover, the bill in its amended form would no doubt prove less objectionable to Arizona and Nevada, which have insisted that they receive revenue from power equivalent to the taxes they would otherwise receive if power development was carried out by private capital."

Fixed Par Versus No-Par Stock

Practice is divided between two systems of issuing stock. Massachusetts considers legalizing the issue of shares without par

HAS the issue of no-par stock become an established institution in public utility finance? The question is again brought forward by the introduction of a bill in the Massachusetts Legislature providing for the legalization of the practice. Massachusetts early introduced legislation prohibiting the use of no-par stocks and has been more or less a leader among those states where no-par stock is prohibited.

Practice in respect to par is divided. Its use in the United States was recommended in 1911 in a report to Congress by the Railroad Securities Commission, generally called the Hadley Commission. It was first introduced in New York State in 1912. No-par stock is now permitted, in so far as common shares are concerned, in about three-fourths of the states, and preferred shares without par value may be issued in approximately half of the states. In some of the states there are further restrictions upon such issue in the case of public utilities. Last year power and light financing in the United States involved a total of about $150,000,000 in the form of common stock, and the bulk of this was issued in shares without par value. Furthermore, a large proportion of preferred stock has recently been issued in no-par shares. Legislative changes have been instituted in several of the states to facilitate the issuance of stock without par value.

That there are two sides to the question is emphasized by the recent attack of a leading economist upon the issue of no-par stock. In "Wall Street and Main Street" Prof. W. Z. Ripley referred to the issue of no-par stock as "an egregious malversation of the rights of shareholders and of the public generally." He states, further, that no-par stock "widens the opportunity for resort to setting up a so-called initial surplus upon the creation of a corporation, and that it distinctly tends to enhance the danger of misrepresentation of expected dividends." Elsewhere he adds: "Is it not obvious that the absolute and uncontrolled power afforded to those new charters to fix the price of each new issue of shares independently of all others reduces the whole matter to the merest gamble on the integrity and judgment of the corporate officers and directors? Most of all, is it not feared that this no-par device is utterly unsuited to all public service companies wherein by all the principles of sound regulation the issue of securities ought not to exceed the actual amount of the investment? Inasmuch as the issuance of no-par shares cuts the ground from under any attempt to correlate closely the amount of the investment and to save its par value for the securities, it is clear that regulation and non-par shares are utterly incompatible one with another."

> Professor Ripley: *The issue of no-par stock is an egregious malversation of the rights of shareholders and of the public generally.*
>
> Hadley Commission: *We do not believe that the retention of the hundred-dollar mark, or any other dollar mark, on the face of the share of stock is of essential importance. We are ready to recommend that the law should encourage the creation of companies whose shares have no par value, and permit existing companies to change their stock into shares without par value.*

Specific Objections to No-Par Stock

Apart from the statements just quoted with respect to no-par stocks, any opposition or criticism which exists appears to be based on technical or practical phases of the question. Certain accounting complications arise in connection with no-par stock, especially with respect to the balance sheet, and a uniform solution is still lacking.

It was brought out in the Hadley Railroad Securities Commission's report in 1911 that no-par stock permits inflation by making it easy to create an excessive number of shares. The same report raises the point that no-par stock divides companies into two classes, those having par value shares and those having no-par value shares, and that this creates confusion. In some states the authorities have refused licenses to form corporations because the non-par feature involves the compilation of fees which have been fixed by statute on the basis of the par value. It was stated that transfer fees, stock taxes, fees for operation in foreign states, etc., may be based upon arbitrary figures in excess of the fair value of the stock. The argument also has been advanced that relieving the stockholders from discount creates an unfair liability to creditors.

After considering the matter from every angle, however, the commission decided: "We do not believe that the retention of the hundred-dollar mark, or any other dollar mark, on the face of the share of stock is of essential importance. We are ready to recommend that the law should encourage the creation of companies whose shares have no par value and permit existing companies to change their stock into shares without par value whenever their convenience requires it. After such conversion, any new shares could be sold at such price as was deemed desirable by the board of directors with the requirement of publicity as to the proceeds of the sale of such shares and as to the disposition thereof, giving to the old shareholders, except in some cases of reorganization or consolidation, prior rights to subscribe pro rata, if they so desired, in proportion to the amount of their holdings."

The commission, moreover, goes on to point out that there are outstanding advantages in the issue of no-par stock where two companies whose shares have different market values consolidate. "It has been the custom to equalize the difference by the issue of extra shares of the consolidated company to the owners of the higher priced stock. This practice has always tended to produce increase of capital issues and may readily cause the new stock to be issued for a consideration less than its par value. The only alternative was to scale down some of the old stocks, and this often involved serious difficulties, both of business policy and of law. By the simple expedient of omitting the dollar mark from the new shares, the number can be adjusted to the demands of financial convenience without danger of misrepresentation or suspicion of unfairness to any one."

In the case of reorganizations the advantage of shares without par value is even more obvious. Says the commission's report: "It is here that the necessity and justice of getting money from stockholders is greatest. It is here that the impossibility of getting them to pay par for new shares is most conspicuous. We believe that in such cases the public interest would be subserved and the speedy rehabilitation of the roads promoted, by requiring the conversion of common stock and encouraging the conversion of the preferred stock into shares without par value, the certificates simply indicating the proportionate or preferential claims of the holders upon assets and upon such profits as might from time to time be earned." While the discussion is dealing with the railroads rather than the power and light situation, it is obvious that the principles apply equally in the latter case.

Advantages of No-Par Stock

Advocates of no-par value shares maintain that their cardinal merit is accuracy. Par value printed on a share of stock, it is urged, is not necessarily a true indication of its real value. Its value obviously depends on the corporation's net earnings and assets both past and future, rather than on the figures printed on the certificate. Basically, a stock certificate is nothing more or less than a statement of ownership of a proportionate share of the assets of some business or organization. It is probable, say its advocates, that the statement of an artificial par value of such share is capable of producing much more misunderstanding than the share without par value. Naturally, shares of stock find their natural level, as with any other species of property, in an open market, and the purchaser or holder is not deceived by any false or fictitious face value of his certificate. It would not be difficult to obtain innumerable examples of shares in mining and similar ventures with a nominal value of $100, but which actually are worthless or nearly so. Par value printed on a certificate makes it easy for promoters to extract money through the irresistible attractiveness of offering a $100 share of stock for $50.

Possibly the strongest argument put forth by advocates of no-par stock is that already mentioned by the Hadley Commission, that the method simplifies consolidation and reorganization. When the par value of a stock is not fixed the number of shares can be readily adjusted to the demands of financial convenience, thus affording relief from an undue inflexibility of financial set-up. This is a matter of decided importance in view of the large number of capital reorganizations in the power and light industry at the moment.

Another argument put forth by advocates of no-par stock is that the incentive for the over-valuation of assets in order to balance the books at the time of reorganization is reduced. Properties can be placed on books at a fair value and capital stock can be credited at the same value. In this way promoters are deprived of the advantage of inflated capitalization and the attention of the investing public is focused upon the real value of the shares. This discourages the carrying of fictitious values in balance sheets of good will, patents and the like, and in an effective way, without delaying or embarrassing legitimate enterprises, carries out the purposes of the so-called blue sky laws. Again, if there is no par there can be no discount, so the stockholder is relieved of the liability for discount resulting from purchase of stock at less than par.

The opposition to no-par stock in Massachusetts is rather a long story and one based on financial principles which have been adopted in New England for many decades. In arguing for the passage of the bill, counsel for the Electric and Gas Association stated that "If the gas and electric companies had no-par value stock, the half-truths which have brought so much ill will to utilities in Massachusetts would be forestalled. The habit of the general public in quoting utilities as obtaining large dividends should be quoted on the par value plus the premium actually paid in by the shareholder."

Oil Well Pumping with Electricity

IN SPEAKING to the convention of the Oklahoma Utilities Association, O. A. Jennings of the Oklahoma Gas & Electric Company presented twelve specific reasons why beam pumping of oil wells is better performed with electricity than with other forms of power. Since his company took on about 36,000 kw. of oil field load in 1927 it seems that Mr. Jennings should speak with adequate authority. The twelve reasons, all of them contributing to lowered cost and increased production, are:

1. Power shutdowns for repairs to prime movers.
2. Easier on belts and rig, which results in less time down for breakage and repairs.
3. Actual experience shows rods unscrew less often and break less often because of the more even and steady motion of the beam.
4. Regular, even motion and exact number of pumping strokes per minute of pumping time means more oil lifted.
5. Fewer rod jobs and lost motion due to shutdown time.
6. Even motion of beam means less "whipping" or "spring" of rods in deep holes.
7. Less time for complete pulling job. No sticking on center, no stalling of back-firing, no clutch troubles. Not necessary for one of the well gang to be making frequent trips to engine house to kick off engine. All men on "derrick floor"; that is, "on the job all the time."
8. Not affected by freezing of water lines, water in gas lines, low steam pressure, poor mixture in cold weather or too rich mixture in hot weather.
9. Ring oil bearings do away with the necessity of daily oiling and the attendant danger from neglect of this duty.
10. Fire risk loss—insurance, both fire and compensation, lower in electrically equipped plants.
11. Impossible for motor to run away, no exploding flywheels, no torn-up rigs.
12. Salvage value of equipment higher than any other oil field power equipment.

The electrical equipment for beam well pumping consists of a double-rated motor in capacities of 10/25-15/30 and 30/65 hp., the lower rating used for pumping, the higher rating for pulling out the rods and tubing when the wells sand up or other troubles occur. This equipment is carried in stock by manufacturers and many oil companies keep extra motors in their warehouses.

Portable Lamps Increase Revenue

By M. Luckiesh
Director Lighting Research Laboratory, National Lamp Works, Cleveland, Ohio

THE present rate at which portable lamps are being bought is approximately 0.3 unit per home per year, representing an average expenditure of about $3.60 per customer per year. Six additional portable lamps can readily be justified in the average home. The lighting equipment for a "conservative ideal" home, based on the minimum requirements for utilitarian and convenient lighting, includes an average of 8.5 portable lamps. Bedrooms account for 2.5 portables. The remaining six are distributed elsewhere. However, extensive surveys indicate that there is an average of only 2.8 portable lamps per home. Considering the present wired homes, therefore, six additional portables would make a potential market for more than 100,000,000 portables, or sixteen times as many as were sold last year.

The portable lamps in use in the home account for at least 49,000,000 sockets. The existing potential market, however, would require a possible addition of at least 100,000,000 sockets, an equivalent of 5,000,000 new residential customers. Five million new residential customers is greater than the number added to central-station lines in the past three years and is nearly one-third of the total number of residential customers in this country.

A 200-watt, direct-indirect, portable operating one hour per day (average socket) increases the average annual gross revenue $5.08. Five small portables containing 50 watts each, burning one hour per day, would increase the average annual gross revenue $6.36. The addition of these six portables, one direct-indirect and five small portables, would alone increase the average annual gross revenue per residential customer from $27.89 to $39.33, or 41 per cent. As long as rates remain unchanged much of this increase in gross revenue is really increase in net revenue.

Portable lamps may provide proper and convenient lighting and add much to the cheerfulness of the home. The portable also earns its keep when not lighted because of its decorative value. Furthermore, it is one piece of lighting equipment which is quite often lighted purely for the charm or decorative note which it introduces in the home.

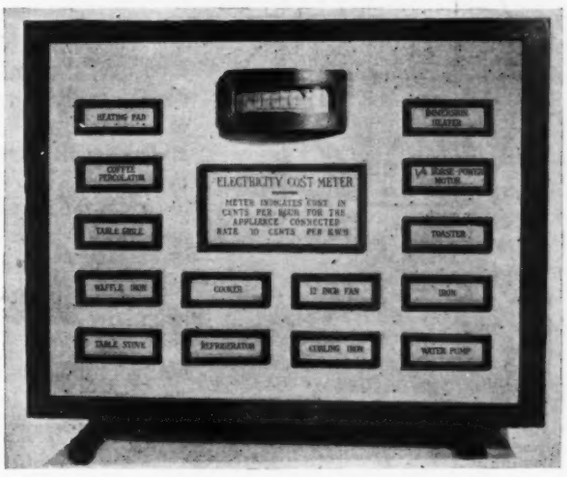
Selling Electric Refrigeration

THE electric refrigeration committee of the National Electric Light Association has recently issued a booklet constituting a general outline of suggested year-round sales and merchandising activities. "Selling the 'Idea' of Electric Refrigeration" is offered as an aid for a more intensive and more effective marketing of electric refrigeration. The activity proposes a co-operative market development effort, bringing together the local electric refrigeration interests, the electric light and power companies, the electric dealers and contractor-dealers, department, hardware, housefurnishing, dry goods, general stores and other distribution channels.

By way of practical illustration the mailing pieces and advertisements now being used by an electric light and power company that is said to have made marked progress in the building of an electric refrigeration load are shown. These items are personalized in each case with the name of the individual electric customer. It is especially pointed out that in this or in any other direct mail campaign a list of prospects should be very carefully selected and prepared. It is stated further that this or any other advertising activity cannot be expected to produce sales unless the utility and other refrigeration dealers carefully plan ahead and follow through with a well-organized personal solicitation. This co-operative plan is not offered as a substitute for the activity of manufacturers, but is designed to pave the way by selling the idea of refrigeration without any reference to particular makes or types.

Appliance-Use Cost Meter

THE cost of energy consumed by various appliances and devices is a matter of moment to all electric service users and it is particularly of interest to those customers, present and prospective, on rural and farm lines. The obvious reason for this interest among rural users is that it is necessary for this class to make large use of energy for other than lighting alone in order to benefit fully from the service and to make the supply of



Meter at top of board successively shows cost of operating each device indicated in panels

that service at least not unprofitable to the utility. The engineering department of Iowa State College devised a display arrangement which shows in cents the costs of using various appliances and equipments at a rate of 10 cents per kilowatt-hour. This display was set up under the direction of Prof. Frank D. Paine of the department, who is also director of the Iowa rural electrification project.

The operation of the display is simple. It consists essentially, as shown in the illustration, of a board on which is mounted an indicating wattmeter calibrated in cents per hour and a number of plates which are illuminated in turn to identify the appliances as they are turned on and off by a flasher.

The display was made up originally to serve as the exhibit of the rural electrification project at the convention of the Iowa Farm Bureau Federation. At this convention the display was seen by more than 3,000 farmers and farmers' wives of the state, in whom it excited much interest. Following the convention the exhibit has been in continuous use by utility companies throughout the state on loan from the college.

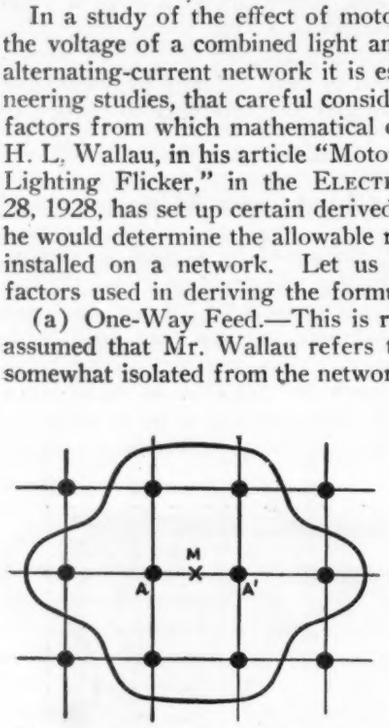
Letters from Our Readers

Motor Starting Current Vs. Lighting Flicker

To the Editor of the ELECTRICAL WORLD:

In a study of the effect of motor starting currents on the voltage of a combined light and power underground alternating-current network it is essential, as in all engineering studies, that careful consideration be given to the factors from which mathematical conclusions are drawn. H. L. Wallau, in his article "Motor Starting Current Vs. Lighting Flicker," in the ELECTRICAL WORLD of Jan. 28, 1928, has set up certain derived formulas from which he would determine the allowable ratings of motors to be installed on a network. Let us examine some of the factors used in deriving the formulas:

(a) One-Way Feed.—This is rather unusual but it is assumed that Mr. Wallau refers to a motor installation somewhat isolated from the network proper. It is hardly conceivable, however, that it would be so isolated as to have only one transformer bank as a source of current. One bank may be considerably closer to the motor installation than several others, but this does not justify the assumption that all the other banks may be neglected in calculations of current fed to the motor. This is especially true when the network transformers have high inherent impedances, as is generally the case.



Motor starting current on underground a.c. network comes from more than two banks of transformers

(b) Two-Way Feed.—The same reasoning applies here as was noted above for a one-way feed. Transformers located at distances further than one-half block from the motor must also be taken into account. This may be shown by the case indicated by the accompanying sketch, in which we have a networked section with 100-kva. transformers uniformly spaced and with 400-ft. blocks and a three-phase motor installation at *M*. The motor location which will result in the greatest voltage disturbance in its immediate vicinity is evidently in the center of the block, as shown. The motor current will be split up among the surrounding banks. However, since the average network system may not be as "stiff" as this one, only the transformer banks within 1½ blocks from the motor, as the boundary line on the sketch indicates, are included in the computations.

The combined cable and transformer impedances from all the included transformer banks to the motor *M* will be 0.0076 ohm (resistance 0.00303 ohm, reactance 0.00696 ohm), assuming 10 per cent transformer impedance and three 500-circ.mil single-conductor cables in one duct. The circuit impedance from the banks *A* and A^1 to *M*, which alone is considered by Mr. Wallau, will be 0.0116 ohm, about 50 per cent higher than that obtained by considering the six other banks. If banks farther away were also taken into account the discrepancy would be larger. It is apparent that the motor size as determined by Mr. Wallau's formulas would be smaller than would be actually allowable.

Mr. Wallau has given a value of 15 per cent as the average power factor or the starting current of induction motors. It is believed that he was referring only to squirrel-cage induction motors when he gave this figure, if such is correct. The wound-rotor, slip-ring type of motor using a resistance starter will have a much better starting power factor.

The ratio of resistance to reactance for the circuit will determine the influence of the motor power factor in the regulation of the circuit. It so happens that in the example noted above this ratio is such that motor power factor does not bear an important part. Thus the allowable motor starting current increment for two volts regulation is 270 amp. for 15 per cent power factor, 260 amp. for 50 per cent power factor, and 300 amp. for 80 per cent power factor.

No attempt should be made to calculate an allowable motor starting current without taking fully into account the actual physical layout of the network system, the type of motor and the motor starter. After a value has been determined it is not necessarily the maximum allowable starting current for the motor. It represents an instantaneous value and must be used on a rate basis. For instance, if 200 amp. will produce a two-volt drop, a motor might have a maximum starting current value of 600 amp. and still not produce an objectionable light flicker provided the 600 amp. are obtained at a definite time rate and not instantly. That is, if a change in voltage at the rate of two volts per second is not objectionable, then the allowable motor starting current can be any amount so long as the rate of increase is not greater than this value.

F. E. JOHNSON,
Distribution Engineering Department.
New Orleans Public Service, Inc.
New Orleans, La.

Time Lag of Spark Gaps

To the Editor of the ELECTRICAL WORLD:

I have just read one of the editorials in the March 17 issue of the ELECTRICAL WORLD, entitled "Time Lag of Spark Gaps," commenting on the work done by J. J. Torok of the Westinghouse company. I feel that the last part of paragraph three of this editorial may be misconstrued and the impression may be conveyed that the sphere gap is not satisfactory as a measuring instrument for high voltages. The actual facts are that this work of Mr. Torok's has demonstrated that while the sphere gap has a time lag which depends upon the steepness of wave front of the surges impressed on it, this time lag is so small that even with the very steepest wave fronts that can be obtained in the laboratory the impulse ratio will probably not be more than 10 per cent and with the steepest wave fronts that have been observed due to lightning the impulse ratio will not be more than 5 per cent.

In fact, Mr. Torok's work indicates that the sphere gap may be considered quite reliable for all practical purposes, though it could hardly be classed as a precision instrument. However, one advantage that we shall gain as a result of Mr. Torok's work will be a better insight into the behavior of the sphere gap during the breakdown period, and as a result we shall no doubt be able to make better use of it as a measuring instrument than we have done in the past.

CHARLES FORTESCUE,
Consulting Transmission Engineer.
Westinghouse Electric & Manufacturing Company.

Digest of Electrical Literature

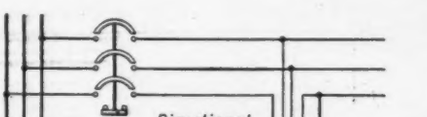
Hydro-Electric Development and Steam Equipment

Binary Mixtures in Steam Engineering.—When mixtures of two substances, particularly those having different boiling temperatures, are subjected to the action of temperature and pressure, their behavior is contrary to that encountered with simple substances, such as water. Ebullition and condensation temperatures vary under constant pressure and new heat cycles and characteristic curves descriptive of them are involved. This discussion includes references to a number of articles appearing in foreign publications and referring to the theoretical and practical considerations of binary mixtures under thermodynamic and border-line conditions. It is stated that cyclic processes involving binary mixtures are of great economic significance when applied to steam engines. The effort to produce higher efficiency leads to an increase in the boiler pressure, but even at the highest technically permissible pressures the evaporation temperature is still far below the limit permissible by the strength of the materials employed. This leads to the employment of binary vapor engines wherein, for example, mercury is used in the upper temperature range and water in the lower. It is contended that the same end may be attained by using a solution as a working medium. The heat is supplied to the evaporator at the highest permissible temperature, while the heat in the mixer is liberated at a temperature which is suitable for the upper range in the heat cycle of the conventional steam engine. The steam generated in the evaporator then performs work in a steam engine against the mixer pressure and is afterward exhausted to the mixer.—*Mechanical Engineering,* April, 1928.

Units, Measurements and Instruments

The Testing of Audio-frequency Transformers by Means of the Cathode Ray Oscillograph.—M. KOBAYASHI.—The cathode-ray oscillograph may, in the opinion of the author, be applied to the determination of the characteristics of apparatus used within a wide range of frequency. The application to the testing of audio-frequency transformers is described and the impedance-frequency characteristics and voltage-frequency characteristics are obtained vectorially from the elliptical figure produced by the cathode-ray oscillograph. The author has made several observations in connection with such test work, including: The impedance and voltage ratios are not constant for all frequencies and, in general, separate resonant frequencies exist for impedance and voltage ratios; if a suitable non-inductive resistance is connected to the secondary of the transformer the impedance and voltage ratio are stabilized against frequency variation; it is desirable in the design of the transformer-coupled amplifier that the secondary be shunted by a certain non-inductive resistance, and the transformer coupling should not be applied to the amplifiers for which phase distortions are undesirable.—*Journal of the Institute of Electrical Engineers of Japan,* February, 1928.

The Impedance Relay.—H. A. MCLAUGHLIN and E. O. ERICKSON.—The developments made in the impedance relay since its introduction in 1923 are reviewed by the author. The features of construction and operation, with special emphasis on the methods of obtaining proper potential for the restraining elements without the use of high-voltage potential transformers, are also noted. The use of potential form condenser type bushings is discussed, and the methods of compensating for the voltage drop through power transformers and for the shifting of the secondary neutral point have been developed in connection with the use of low voltage potential. The authors state that the impedance relay, while relatively new in the field of protective devices, is already being used extensively both in this country and abroad. Because of the impossibility of obtaining satisfactory results with over-current and directional relays in some cases, and the objectional time delays involved even when selectivity can be obtained, the impedance relay is receiving more and more consideration. This is stated to be a step in the right direction, since the impedance principle involves a relay independent of system conditions and dependent on direction of current flow for its operation and on distance from the fault for its time. Many improvements and developments have been made as the result of operating experience which has resulted in a better understanding of the operation of this device.—*Journal of the American Institute of Electrical Engineers,* April, 1928.



Directional-control impedance relay

Transmission, Substations and Distribution

A General Solution for Short Transmission Lines.—C. M. LONGBOTTOM.—The author has endeavored to describe a general solution by which voltage regulation may be ascertained quickly and with reasonable accuracy. The basis of this method is the circle diagram and formulas and charts are given to illustrate the contention and aid in the solution of problems. The effect of the length of line, the line-phase angle, the load power factor, the regulation of a short line, and regulated and unregulated line values are given. A tabulated card index for certain standard conductor sizes is offered and suggested for ready reference in correlating the values of the several factors involved.—*Electrical Engineer (Australia),* Feb. 16, 1928.

Safety Interlock for High-Voltage Apparatus.—M. JUMIER.—It is customary to provide inclosing doors for cells in high-voltage indoor power installations, to prevent access to live parts. An arrangement is described in this article by which all such doors may be closed by locks operated by a master key. The latter may be kept in a small metal box, located near the main oil switch. This box has a hinged cover, which cannot be opened until the oil switch has been tripped. Only then is it possible to obtain the key and unlock the doors to the various cells, which are now dead. On the other hand, the oil switch cannot be closed until every cell door has been closed again, the key has been returned into the box and the lid of the box has been shut. In addition, red and green signal lamps are connected to all doors and the contact in the box, to show the attendant optically the position of doors and the main switch. This is claimed to be the most foolproof safety interlock known.—*Revue Générale de l'Electricité,* March 3, 1928.

Three-Winding Transformer Banks.—G. D. FLOYD.—Operating features of three-winding transformer banks have been considered by the author. A theoretical study of simple cases of parallel operation of typical transformer banks is included, showing the effect of various methods of operation on the maximum load that can be carried on the windings and the consequent reduction in transformer bank capacity. Some generalized conclusions are drawn from a study of load unbalancing and parallel operation; a three-winding transformer where load is taken from both secondary and tertiary including parallel operation of secondary and tertiary windings is essential for equal division of loads among the transformers; the utilization of available capacity becomes greater as the number of banks increases, other things being equal; it is desirable, from a utilization standpoint, to be able to

divide the 110-kv. bus into sub-systems; if one or more tertiary groups of feeders are lightly loaded and the others relatively heavily loaded, better utilization of available capacity can be made by supplying the lightly loaded group over the reactor bus, and opening the tertiary supply from its transformer bank, and the voltages on the tertiary group of feeders are not materially different for considerable unbalance in tertiary loads. —*Electrical News (Toronto)*, April 1, 1928.

Illumination

Lighting Spray Booths.—A. H. NUCKOLLS.—As a result of an investigation to determine the most desirable method of safeguarding the electric lighting arrangements for spray booths several practices have been developed. It is stated that in such work there are two distinct phases of fire hazard to consider, the volatile liquid solvents, the vapors in admixture with the air being flammable, and the non-volatile solids or residue, which are flammable and easily ignited under moderate heat. The residue and vapors when present in the air as a mist or cloud may, under certain conditions where there is a source of ignition, offer a flash fire or explosion hazard. In order to obtain information regarding the dangers involved, a series of measurements were obtained of maximum temperature of various parts of vapor-proof and mercury vapor lamps, fixtures and auxiliaries by means of accurately calibrated thermocouples. A series of tests to determine the surface temperatures likely to cause ignition of spray residues such as are commonly used was also made. A series of spray tests in which the spray was applied directly to the lighted lamps, fixtures and auxiliaries while in operation was carried out. The result as indicated in temperature readings at various points on standard fixtures is offered in condensed form.—*Laboratories' Data (National Board of Fire Underwriters)*, March, 1928.

Motors and Control

The Three-Phase Compensated Induction Motor.—TOSHIO SUGIE.—The various advantages and relative merits of the several types of induction motors and of a compensated machine of this type are compared by the author. The theory of the compensated induction motor is described and the best results with respect to the load characteristics with various brush positions and the effect of voltage variations and of frequency variations, as obtained with a test machine, are considered. It is stated that though the motor has a limitation of maximum possible capacity so far as design considerations are concerned, there is no obstacle due to this limitation with the motor capacities ordinarily used for industrial purposes. This device is said to possess speed characteristics and starting characteristics comparable to those of a wound-rotor induction motor and to incorporate a series compensation comparable in dependability to that obtained with parallel compensation. The primary windings are arranged in the stator and the construction is stated as being simplified. The power factor approximates 90 per cent.—*Journal Institute of Electrical Engineers of Japan*, February, 1928.

Heat Applications and Material Handling

Railroad Bridge Made by Arc Welding.—A. G. BISSELL. What is said to be the first all-welded bridge to carry rail traffic has recently been completed in Pennsylvania. The details of design and the fabrication procedure have been outlined by the author and the data for material and labor requirements are included. A series of tests were conducted upon this structure to determine deflection and vibration by running a locomotive across the bridge at various speeds.—*Iron Age*, April 12, 1928.

Electrophysics, Electrochemistry and Batteries

The Effect of Impurities and Moisture upon the Breakdown Voltage of Transformer Oil.—Y. TORIYAMA.—The voltage-current curves of various transformer oils have been derived by the author from the breakdown value when using sphere and plate electrodes. It is stated that the results indicate that the curves are influenced not only by the form of the electrode but by the existence of dust and moisture in the oil. The combined effect of fibrous dust and moisture upon the breakdown voltage under uniform stress is given particular consideration, with particular reference to the former impurity. It is stated that in well-filtered oil this fibrous dust is very thin, and it has been assumed to be of ellipsoidal shape. On the basis of this assumption, the breakdown voltage of the transformer oil has been calculated, and the results are said to correspond closely to theoretical considerations.—*Journal Institute of Electrical Engineers of Japan*, January, 1928.

Extreme Ultra-Violet Spectra Excited by Controlled Electron Impacts.—K. T. COMPTON and J. C. BOYCE.—This investigation is the outgrowth of an unsuccessful attempt to photograph, by ordinary spectroscopic methods, the spectrum of soft X-rays excited in solid targets by the impacts of electrons whose energies are of the order of 100 volts. Numerous experimenters have detected such radiation by photo-electric means, and the desirability of securing a direct spectroscopic check on the interpretation of the breaks found in their curves of photo-electric current versus bombarding voltage was evident. A modification of the original apparatus designed for use in the study of gases under somewhat different conditions from those hitherto employed permitted the desired determination. In this instance gas molecules have been substituted for the solid target previously used and conditions so adjusted that all radiation from them arises from single impacts by electrons of known and controlled velocity. It is stated that the gases have also been handled in such a manner as to insure such a high degree of purity that there is little room for doubt regarding the origin of the lines appearing in the spectrum. The apparatus used in this determination and the spectrograph light source and the method of handling the gases are given in detail. Data regarding the spectra of helium and neon and argon are included.—*Journal of the Franklin Institute*, April, 1928.

Miscellaneous

A New Method of Separating the Hydraulic Losses in a Centrifugal Pump.—MICHAEL D. AISENSTEIN.—Particulars of a method by means of which the friction and shock losses of a given pump may be determined separately from its head-capacity curve. The author has concluded his mathematical discussion and derivation of formulas with the analysis of a specific problem in design. A consideration has been offered of the apparently inconsistent expression for hydraulic efficiency which often amounts to less than the actual pump efficiency. The latter includes, besides hydraulic losses, mechanical losses such as disk friction, friction in stuffing boxes, etc. The reason for this inconsistency is said to repose in the fact that the theoretical head in feet for an impeller with an infinite number of vanes is never produced by the impeller and is an imaginary quantity because the average actual angle between the relative velocity and peripheral velocity is always less than the casting angle of the vane, so that the drop between the theoretical head in feet for an impeller with an infinite number of vanes and the theoretical head in feet for an impeller with a finite number of vanes does not consume any power and is not a loss.—*Transactions of the American Society of Mechanical Engineers*, January-April, 1928.

Physical Properties of Lead Cable Sheaths.—P. DUNSHEATH.—The author has discussed some of the troubles that may arise from the practical use of lead cable sheaths owing to physical weaknesses in the materials utilized and has indicated how these weaknesses are connected with the inherent grain structure in the metal and the streamline structure due to the extrusion process. Existing metallurgical knowledge is reviewed and illustrations are given from the author's investigation into the crystal structure of cable sheaths. Various factors involved in the much-discussed disintegration by vibration theory are examined and the improvement of pure lead by the employment of alloying metals is treated both theoretically and practically. Special apparatus for the vibration tests is described and a consideration of the "weld" and a description of a new type of cable press which produces a cable sheath that is weldless are also noted.—*Journal of the Institution of Electrical Engineers (England)*, March, 1928.

News of the Industry

Flood-Control Bill Appropriates $352,500,000

The Jones-Reid flood-control bill, carrying provisions which critics of the measure assert involve a total expenditure far beyond a billion dollars, was passed by the House of Representatives this week by a vote of 254 to 91. It had previously passed the Senate by 70 to 0. A possible presidential veto confronts it.

The bill authorizes appropriation of $325,000,000 for flood control works on the Mississippi, provides $17,500,000 in addition for flood control on the Sacramento River in California, and also makes available the unexpended balance of $10,000,000 previously authorized for survey of reservoirs on tributaries of the Mississippi. A planning board to be made up of the chief of the army Corps of Engineers, the head of the Mississippi River Commission and a civilian engineer is charged with the duty of reporting to the Executive before any definite plan of control is carried forward. The federal government is protected against damages to public utilities, which leaves them at liberty to sue for loss in accordance with their constitutional rights.

Bay State Speaker Against Hasty Action

Speaker John C. Hull of the Massachusetts House of Representatives, at a hearing Wednesday before the joint rules committee, opposed action looking toward further public utility legislation in the Bay State pending a decision by the courts in the Worcester rate case. The committee was considering the resolve for an investigation of ways and means for further regulation of gas and electric utilities in the state. The Mayors of Cambridge, Somerville, Brockton, Lowell, Marlboro, Revere and Lawrence favored the resolve. Senator Gaspar G. Bacon, chairman of the committee on power and light, also declared that the proposed investigation should wait on the Worcester case.

Lackawanna Road Has 76-Mile Electrification Plans

Coming electrification in New Jersey by the Delaware, Lackawanna & Western Railroad will, according to an announcement made by President J. M. Davis this week, include the Morris & Essex line from Hoboken to Dover, the Passaic & Delaware to Gladstone and the Montclair branch—a total of 76 miles of road or 173 miles of track, at an expenditure of approximately $14,000,000. Mr. Davis added:

"Officials of the company are carefully weighing the advantages and relative cost of purchasing electric power from outside companies as compared with the construction of a generating plant and manufacturing its own power. The construction and equipment of the proper power plant and accessories would cost about $4,250,000 and would raise the total cost of this electrification work to the neighborhood of $18,000,000. Construction work will be started just as soon as the Lackawanna engineers can prepare plans, and it is estimated that it will be completed within two years."

Jackson & Moreland of Boston have been appointed engineers to carry out the railroad company's plans, and it is probable that orders for all equipment will be placed within sixty days.

Trade Commission Looks Into Propaganda

Expenditures of Joint Committee of National Utility Associations Subject of Inquiry—Income of N.E.L.A. Also Put on Federal Body's Record

PAYMENT of substantial counsel fees to former Senator Irvine L. Lenroot of Wisconsin and Richard Washburn Child, former Ambassador to Italy, by the Joint Committee of National Utility Associations was revealed on Tuesday, April 24, at the Federal Trade Commission's investigation into public utilities.

Particulars of these payments were contained in the testimony of Ira L. Grimshaw of New York, assistant director of the joint committee. He said that Mr. Lenroot received $20,000 to oppose the Walsh resolution proposing the inquiry before the Senate interstate commerce committee, and that $7,500 was paid to Mr. Child for writing a book for the joint committee about the Boulder Dam project. • •

Producing an account book taken by the investigators from the files of the joint committee, Robert E. Healy, chief counsel for the commission, asked Mr. Grimshaw to identify payments noted in it. Mr. Grimshaw testified that $5,000 had been paid as an initial fee to Ernest Greenwood, a former newspaper man, for writing a book, "Aladdin U. S. A.," brought out by Harper's, and that J. Bart Campbell, a Washington newspaper man, was receiving $150 a month from the committee in payment for utility news gathered by him and sold to the joint committee. He did not act as a publicity agent.

George H. Francis of New York, auditor for the joint committee and the National Electric Light Association, testified that besides its yearly income of more than $1,000,000, the N.E.L.A. has handled a special fund for educational and research work to which the larger power companies contribute in addition to taking care of the deficiencies incurred by the association.

Mr. Grimshaw presented a table of total contributions of $1,000 or more by groups of utility companies to the Joint Committee of National Utility Associations. These numbered 26 in all, the ten largest contributors being: Insull companies, $61,750; Electric Bond & Share companies, $60,994; Byllesby companies, $36,992; Brady companies, $32,000; North American companies, $28,000; United Gas Improvement companies, $20,000; Columbia Gas & Electric, $20,000; Public Service Electric & Gas, $20,000; Doherty companies, $16,000; Stone & Webster companies, $16,000.

Debate on Boulder Dam Bill Begins in Senate

Discussion of the Swing-Johnson Boulder Dam bill was beginning in the United States Senate on Thursday as the ELECTRICAL WORLD closed its forms. Prediction from Washington is that the measure will be before the Upper House for at least a week.

The House rules committee at a session on April 24 reached no decision in the matter of granting priority in the consideration of the Boulder Dam bill. Representative Smith of Idaho, chairman of the committee having jurisdiction, is requesting a rule to allow six hours of general debate to be divided equally between those favoring and those opposing the bill. In requesting priority ruling for the measure, Mr. Smith stated that, after considering the matter for six years, Congress should settle the controversy by enacting legislation authorizing construction, subject to ratification by six of the seven states involved. Chairman Snell of the rules committee pointed out that it ought to be possible to provide for flood control without going into power development.

Representative Taylor of Colorado stated the case for the upper basin states, bringing out that their chief concern is in preserving their water rights. "There are three ways of settling the question of allocation of water," he said—"first, for the states to come to an agreement among themselves; second, for the Supreme Court to decide the question as it did in a dispute between Colorado and Kansas over division of the water of the

Arkansas River, and, third, for Congress to adopt legislation making the allocation. Since the states will not agree nor accept a ruling from the Supreme Court, the only remaining way is to let Congress decide."

Los Angeles "Times" Is for Flood Control First

Harry Chandler, publisher of the Los Angeles *Times*, speaking at a dinner tendered to him and other newspaper men in New York on Wednesday evening, told of the difficulties in the way of agreement on the Boulder Dam project on the Colorado for irrigation and power and predicted that some parts of the plan would have to be abandoned, at least temporarily, and agreement reached on a flood-control dam. Politics and mistaken opinions so surrounded the project contemplated in the Hoover compact that the seven states involved could not unite, he said; but all elements admitted the necessity of a dam to eliminate the always present threat of inundation in the Imperial Valley. If the dam were built with a wide enough base, developments for power might come later.

Tacoma May Ask Bids for Second Cushman Unit

The city of Tacoma, Wash., contemplates letting contracts for construction of the second unit at its Cushman plant before the end of the year. The major contracts will be for a dam and a tunnel 2½ miles long to carry the water to where it will be dropped down through steel penstocks to the second power house.

In the first unit of the new Lake Cushman plant, completed early in 1926, the city is developing 50,000 hp., and at the sixteen-year-old La Grande plant on the Nisqually River it is developing 32,000 hp. In the second unit of the Cushman plant, the engineering survey for which is now under way, there will be developed 140,000 hp., according to the present plans of the city engineering department. It will also pave the way for the installation of 25,000 additional horsepower at the first Cushman power house, giving the city altogether a future total of 247,000 hp.

Rural Electrification Project on National Scale

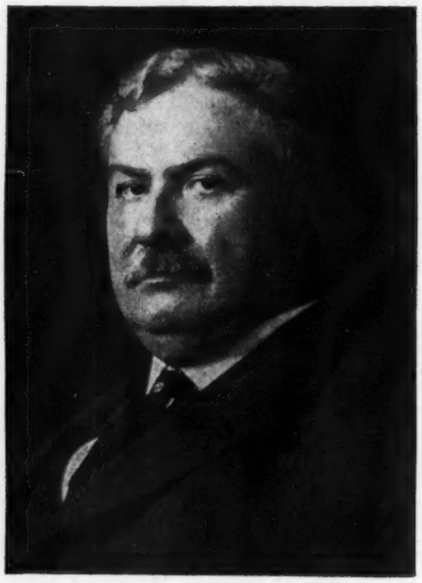
Under the auspices of the Committee on the Relation of Electricity to Agriculture, operating in conjunction with a Maryland state committee, a new experimental enterprise, to be known as the "national rural electric project," is soon to be established. It will be within easy driving distance of the national capital, probably adjacent to the highway between Washington and Baltimore. One of the first steps will be the erection on the grounds of the Agricultural College of the University of Maryland at College Park, on this national highway, of an exhibition building in which will be housed displays illustrative of the experiments being carried out on the national project and also on the various state experimental lines.

In some community not far from College Park six or eight farms, in a cluster if possible, will be selected as a base for the experiment. Dr. R. A. Pearson, president University of Maryland, heads the Maryland committee.

It is expected that it will take five years to obtain all the information desired. The National Electric Light Association, represented by Charles F. Stuart, chairman of its rural electric service committee, is participating.

Death of James J. Wood

Consulting Engineer at General Electric Company's Fort Wayne Works Since 1890—His Prominence in the Early Days of Arc Lighting



JAMES J. WOOD, consulting engineer of the Fort Wayne works of the General Electric Company and one of the pioneers of electric lighting by arc lamps in America, died suddenly on April 19 at Asheville, N. C. He had just passed his seventy-second birthday and had gone to Asheville in an endeavor to recuperate from illness.

Mr. Wood was born at Kinsale, Ireland, being brought to America at the age of eight. The family lived in Connecticut for more than ten years. At the age of 18 he was graduated from the Brooklyn evening high school and in 1878 from the Brooklyn Polytechnic Institute. At that time the Brady Manufacturing Company, for which young Wood worked while pursuing his studies, was making castings and parts for electric dynamo machines invented by James B. Fuller of the Fuller Electric Company and by Hiram S. Maxim, then chief engineer of the United States Electric Lighting Company. As machine-shop foreman young Wood directed the construction of these machines and soon became interested in the electric lighting idea himself.

In 1879, after much private study and experimenting, he designed and built an arc-light dynamo of his own. This dynamo was so efficient that it caused the Fuller Electric Company to substitute Wood's machine for Fuller's and change the company name to the Fuller-Wood Company. After about ten years' service as electrical inventor for this and other companies in New York, Mr. Wood went to Fort Wayne in 1890, as the result of a commercial agreement with the old Thomson-Houston company, which then had a large interest in the contemporary Fort Wayne Electric Works. He had remained there ever since as the outstanding electrical engineer of the Fort Wayne plant.

When Mr. Wood went to Fort Wayne his dynamo and arc lamp were already in use extensively under the name of the "Wood arc-lighting system." He added accessory equipment to the system while at Fort Wayne, inventing types of meters and switch devices, as well as alternating-current dynamos and some of the earliest electric fans to be placed on the market. Before this he had been concerned in the manufacture of the Brayton oil engine installed in the first Holland submarine, and he built the first lamps for Hiram S. Maxim and the machines for constructing the main cables used on the original Brooklyn Bridge. His patents, numbering 240, included one for a dynamo for flood-lighting which was first used on the Statue of Liberty.

Mr. Wood was a fellow of the American Institute of Electrical Engineers and a member of the Quarter Century Club of the General Electric Company.

Tokyo Congress Plans

Many American Engineers Will Journey to Japan in October, 1929, to Take Part in World-Wide Conference of Technical Men

A CABLEGRAM was received last Saturday by Maurice Holland, executive secretary of the American committee of the World Congress of Engineers to be held in Tokyo next year, from Baron C. Shiba, vice-president of the congress, outlining the plans and program. The meeting, Baron Shiba states, will convene in Tokyo on Oct. 30, 1929. The official languages of the congress will be English and Japanese. The first week will be devoted to technical papers and social meetings, the second week to inspection trips in Tokyo and vicinity, and the next fortnight to trips throughout Japan especially arranged to give the delegates an opportunity to visit the great industrial and engineering centers of the country.

The World Congress, which will be attended by engineers and scientists from all parts of the world, is designed to promote international co-operation in the study of engineering science and problems, and international authorities on engineering are being requested to

prepare papers on subjects of interest and moment to engineers. Many notable technical men from America will attend the congress, eighty of the nation's foremost engineers and scientists having, as already reported, accepted membership on the American committee under the honorary chairmanship of Secretary Hoover and the active chairmanship of Dr. Elmer A. Sperry.

Dr. Sperry has made public the names of members of the various American committees charged with carrying out the plans for the undertaking. The chairmen are: Finance, John W. Lieb; technical program, Dugald C. Jackson; transportation, Frank B. Jewett; entertainment, O. C. Merrill; publicity, J. H. McGraw; promotion and attendance, George W. Fuller. These chairmen, with Gano Dunn, Maurice Holland, Charles F. Scott, Elmer A. Sperry, W. E. Wickenden and Calvin W. Rice, will make up an American executive committee under the chairmanship of Mr. Lieb.

Purchases and Mergers

Scattered Transactions of Comparatively Small Importance Compose the Week's Record — Tendency to Consolidate Subsidiaries Continues Manifest

THE eleven companies which, as reported last week, are to be taken over by the Metropolitan Edison Company as part of the General Gas & Electric's plan to simplify the corporate structure of its subsidiaries are the Ortanna Electric Light & Power Company, the Boyertown Electric Company, the Annville & Palmyra Electric Light Company, the Bernville Light, Heat & Power Company, the Berks-Lehigh Power Company, the Birdsboro Electric Company, the Hamburg Gas & Electric Company, the Topton Electric Light & Power Company, the Weisenberg Township Electric Light & Power Company, the French Creek Electric Company and the Blue Mountain Electric Company.

The Harlem Valley Electric Corporation has filed a petition with the Public Service Commission of New York to acquire the franchises and plant of the Eastern New York Electric & Gas Company, which has its principal office in Mechanicville and distributes electricity in the villages of Brewster, Chatham, Pauling and Philmont and in many towns in Rensselaer, Columbia, Dutchess and Putnam Counties. Both companies are controlled by the Associated Gas & Electric Company.

Sale of the Rock River Valley Light & Power Company, a distribution system serving Barstow, Joslin and Hillsdale, Ill., to the People's Power Company of Moline awaits only approval of the Illinois Commerce Commission. The price was $30,000.

Sale of the electrical distribution system of the city of De Soto, Kan., to the Bonner Springs division of the Kansas Electric Power Company, Lawrence, has been agreed upon by the City Council. De Soto has heretofore purchased power wholesale from the Kansas Electric Power.

The municipal light, ice and water plants of Donalsonville, Ga., have been sold to the Georgia Power Company for $50,000.

The municipal electric plant at Vidalia, La., has been acquired by the Southwestern Gas & Electric Company.

Twenty per cent reduction in rates for Quincy (Calif.) electric consumers will result from the purchase of the Quincy Electric Light & Power Company by the Great Western Power Company of California.

Stockholders of the American Power & Light Company, meeting in Augusta, Me., on Tuesday, ratified the plan to exchange preferred stock for the common stock of the Montana Power Company. This makes the merger of the companies effective, as John D. Ryan and associates, who held control of Montana Power, have agreed to the two-to-one plan of exchange.

Reports from Chicago tell of a geographic readjustment of Insull-controlled companies by which the Middle West Utilities Company will have a majority interest in the National Electric Power Company and the Inland Power & Light Corporation, acquired last year from the Albert Emanuel and the A. E. Fitkin interests respectively. As a result of this transaction the New England Public Service Company, a Middle West Utilities subsidiary, has been transferred to the National Electric Power Company, which will be the holding company for all the properties of the system operating in the East, while the Kansas Electric Power Company, the Southwest Power Company and the Northwestern Public Service Company, former National Electric Power subsidiaries, have been transferred to direct control of the Middle West Utilities Company. The Inland Power & Light Corporation subsidiaries, operating in Kansas, Missouri, Arkansas, Texas and Michigan, are expected to be combined with the other Middle West Utilities properties on a geographic basis.

I. W. Day Elected President of New England N.E.L.A.

Irvin W. Day, vice-president of the Connecticut Light & Power Company, Waterbury, Conn., was elected president of the New England Division of the National Electric Light Association at the annual meeting on Tuesday of this week at Boston. Other officers chosen were: Vice-president, C. H. Hodskinson, Boston Edison company; treasurer, F. L. Ball, Charles H. Tenney & Company, Boston; executive committee, George S. Williams of Maine, W. A. Buttrick of New Hampshire, W. C. Bell of Vermont, H. E. Duren of Massachusetts, David Daly of Rhode Island, A. D. Colvin of Connecticut and F. D. Gordon, ex officio. Section chairmen elected were: Accounting, J. W. Lester, Boston Edison company; Commercial, A. S. Moore, Brockton Edison company; Public Relations, Haller D. Seavey, Western Massachusetts Companies; Engineering, Frank R. Fowles, Portland, Me.

Following the election, Philip Cabot, professor of public utility management, Harvard Graduate School of Business Administration, gave an address upon the use of electricity in the home, predicting that this class of central-station business will ultimately become the most profitable of all. He predicted that within fifteen years comparatively little appliance business will be done by central stations in view of the progressive developments of other outlets.

Five Electrical Pioneers Meet at Franklin Institute

Thomson *Sprague* *Brush* *Sperry* *Rice*

WORTHY of note was an assemblage at the Franklin Institute, Philadelphia, last week, when five men who have played distinguished parts in electrical history stood grouped around an ancient dynamo. They were Charles F. Brush, Elihu Thomson, Frank J. Sprague, Elmer A. Sperry and Edwin W. Rice, Jr. Dr. Brush, now 79, who made the dynamo, and Dr. Thomson, now 75, were the developers of rival arc-lighting systems in their early days, and each of the three younger men is old enough to have been an engineer of note when the art was in its infancy. Dr. Brush and Dr. Thomson were speakers at a meeting which followed the reunion.

M. J. Insull Explains Situation on Colorado of Texas

Following an inspection of the properties of the Middle West Utilities Company in west Texas, Martin J. Insull of Chicago, head of the company and its several subsidiaries, made the statement at Abilene, Tex., last week that he may abandon the project of constructing a series of six dams and hydro-electric projects on the Colorado River, which would have involved an expenditure of approximately $25,000,000. The failure of the Brownwood Irrigation District to give the Insull interests an assurance that it will recognize priority rights of the Middle West Utilities Company on the 580,000 acre-feet of water of that stream which it proposed to use in the development of power was given as the reason for this possible change of plans.

"Unless we are given this assurance, we will not proceed with our project," Mr. Insull said. "I did not want to get mixed up in any dispute between any sections of the state, neither did I want to get into the hydro-electric power business in this state. I do not believe that it is a particularly profitable business. I would much rather buy the power from some one else at the dam than to build the dams. Lignite and oil will produce power today cheaper than water power on the Colorado River. When the Syndicate Power Company presented its plan for power on the Colorado River, we did not think that it was a particularly good business deal. We thought it was a good thing for Texas and that anything that was good for Texas was good for us. When our proposition failed to meet with approval of the West Texas Chamber of Commerce and when that body turned down our offer at Dallas, we got out of the Syndicate Power Company."

Another Grandiose Scheme Proposed for Canada

Another ambitious plan for navigation and power has been put before the Canadian Parliament. Last year it was the Georgian Bay canal scheme, sponsored by the Sifton interests, which occupied the attention of the House through fourteen sittings. This year it is a bill to detail certain powers to the Great Lakes & Atlantic Canal & Power Company, which was incorporated 24 years ago, with general powers subject to the approval of the government. This company's proposal is to construct a 35-ft. waterway from tidewater to the Great Lakes at an outlay of approximately $200,000,000. In the process 2,800,000 hp. of electrical energy would be developed in the Province of Quebec, the promoters say.

Sponsors of the proposal think that it meets all the objections voiced in connection with St. Lawrence development. They declare that it will provide, without cost to the Dominion or provinces, an all-Canadian waterway, thereby relieving the country of financing and at the same time providing a route which Canada could control. The bill provides for a canal system from either Cornwall or Prescott to Lake St. Francis, and thence to Beauharnois and back to the St. Lawrence River in the neighborhood of Montreal.

The Great Lakes & Atlantic has notified the government of its willingness to complete the navigation works and turn them over to the government to operate without compensation, the power rights being sufficient inducement to proceed with the work.

How Germany Solves Electric Problems

Bin and Unit Pulverizers Both in Use in Central-Station Plants —High-Pressure Steam in Favor—Agricultural and Railroad Electrification—Statistics for 1927

By Dr. Gerhard Dehne*

Berlin, April 1, 1928.

A COMPLETE cessation of the building of power plants in Germany followed the war, but at the same time there arose a demand for electricity which made enlargements of existing installations imperative, and these had sometimes to be made hastily without waiting for the proper development of engineering ideas. Journeys to America were made by German engineers to study the new developments there, and some of these have now been applied to German plants with modifications and sometimes innovations that German conditions call for.

Most American plants burning pulverized coal use a central coal mill—the "bin system," as it is called in America—and some of the largest German plants—for example, the Klingenberg plant in Berlin—have adopted this method. Many private plants, however, have installed unit pulverizers, simplifying construction. This method was followed in the new plant of the communal Elektrizitätswerk Mark in Westphalia with such good results that it is likely to grow in use. Electrical filters to eliminate gas fumes have been employed by the Leunawerke with success.

In America boilers have long operated at a pressure of 84 to 100 atmospheres. In Germany the Grosskraftwerk Mannheim operates with a pressure of 100 atmospheres. In the Siemens-Schuckert cable works there was installed last year a Benson boiler at 230 atmospheres, which burns 30 tons of pulverized coal an hour, and boilers burning from 30 to 40 tons were installed in 1927 in many power houses without causing any difficulty.

The largest two-pole turbo-generator in Germany produces 40,000 kva. at 80 per cent power factor. The largest units with four poles (two-shaft machines)—those in the Klingenberg plant—have a capacity of 80,000 kw. each. The largest machines running at 3,000 r.p.m.—which are considerably cheaper than 1,500-r.p.m. machines—work very successfully in the Hamburg station, producing 37,500 kva., and preparations have been made to raise their rating to 50,000 kva. An experimental 44,000-kva. generator is already operating.

Some figures regarding the application of electricity to German agriculture were brought out in "Agricultural Week" in the Berlin exhibition halls recently. Use of electrical power increased from 1907 to 1925 by 3,000,000 hp., electric motors with a total rating of 3,334,051 hp. being in use in the last-named year. However, only 12.6 per cent of the farms are operated by electricity.

The electrification of the Breslau-Königszelt railroad in Silesia, completed in January, draws attention to a market for electrical energy which is becoming more important every year, that furnished by the German state railroads. Electrification began on a small scale before the war. Most of the work, however, has been accomplished in the last few years. Omitting the suburban districts of Berlin and Hamburg, there are three separate railroad systems—in central Germany (Leipzig-Magdeburg), in Bavaria around Munich and in Silesia (Breslau-Görlitz). In Bavaria the railway plants are operated by the water powers of the Alps, in Silesia by the less valuable pit coal and in central Germany by brown (soft) coal, which is coming into extensive employment. The whole length of the state lines, which include nine-tenths of all German railroads, was 33,306 miles in January, 1928. Of this, 760 miles were electrified, geographically divided as follows: Bavaria, 381; Silesia, 160; central Germany, 117; Berlin, 49; Baden, 30; Hamburg, 23. In 1928 the electrification of the Berlin urban and suburban railways, with a length of about 310 miles, will be finished.

According to reports by the "chambers of industry and commerce" and statements made by Dr. Carl Friedrich von Siemens at the annual meeting of the Siemens & Halske company, 1927 was in most branches of the German electrical industry a very satisfactory year. Seventy-five per cent of the electrical energy used in Germany is produced in plants owned or controlled by the nation, the states or the communes. These public utility undertakings have recently placed contracts for electrical equipment and supplies of various kinds.

*Dr. Dehne's first Berlin article appeared as a letter to the editor on March 24 (page 619).

Electrical Engineers at Conowingo

Inspection of Plant Follows Full Discussion of Its Features at Closing Sessions of Baltimore Regional Institute Meeting

A TRIP to Conowingo participated in by 128 of the delegates to the regional meeting of the Middle Eastern District of the American Institute of Electrical Engineers, held in Baltimore, brought it to a successful close on Friday, April 20. The earlier sessions were reported in the ELECTRICAL WORLD last week. Those of Thursday were devoted to the design, transmission, communication and operating stability features of the Conowingo development. Following a general review of the economic factors which led to the erection of the power plant at this site, Alexander Wilson, 3d, outlined the construction methods utilized and the design of the hydraulic equipment.

The electrical features of the Conowingo plant and of the receiving stations in Philadelphia were reviewed by R. A. Hentz. These include a 220,000-volt substation built on the roof of the power plant, a 30,000-kva. synchronous condenser installed for stability purposes at Plymouth Meeting, and three-winding 220/69/13.3-kv. self-cooled transformer banks arranged for tap changing under load.

The 220-kv. transmission line between Conowingo and Plymouth Meeting was described by P. H. Chase. Two single-circuit tower lines, each with double-ground wire protection, are used. Conductors are of 795,000-circ. mil steel-reinforced aluminum. Slip clamps are used to decrease unbalanced longitudinal stresses on the towers in the event of conductor breakage.

In the discussion following the presentation of these papers F. G. Baum welcomed the introduction of 220-kv. lines in Eastern practice and mentioned the satisfactory service yielded by such construction for many years in West Coast work. R. L. Thomas called attention to the agreement with the Holtwood plant, further upstream, under which water is purchased with a net gain of from 84,000,000 kw.-hr. to 100,000,000 kw.-hr. yearly. P. L. Alger commented upon the use of rotors built up on the job, with heavy plates and riveted construction, and installed, consequently, without factory-shop tests.

The communication system for use in the plant in connection with the transmission line and in load dispatching was outlined in a paper by W. B. Beals and E. B. Tuttle. The value of co-operative consideration of such problems by utility and telephone company engineers was suggested as desirable at an early stage in the planning of the project.

A quantitative mechanical analysis of power-system transient disturbances as applied to the problems arising in the several interconnections involved in this three-company tie-in was detailed by R. C. Bergvall and P. H. Robinson in a paper read by the former. Records were obtained by taking motion pictures of an equivalent mechanical system.

The superexcitation of synchronous condensers for the Conowingo system, with particular attention to the design limits of the excitation equipment and the possible emergency condenser output, was treated by D. M. Jones.

In the ensuing discussion F. G. Baum pointed out the value of synchronous condensers in increasing the capacity of the line by taking care of the line-charging capacity, which at one time presented a difficult transmission-line problem. A. E. Bauhan said that with the three-company tie introduced by the present interconnection he anticipated an increased number of voltage dips and relatively unimportant disturbances, but that these would not, he felt, be of a serious nature in general. A. F. Bang questioned the desirability of mounting an outdoor switching structure on the roof of the generating station, as limiting future expansion and introducing oil-fire hazards, and expressed disapproval of the plan of placing reactances on the high-voltage side of transformers in transmission work while using them on the low-voltage side in cable distribution practice.

Symposium at New Haven on Surge Measurements

In addition to the papers covering electric power on street railways and the electrification of steam railroads which, as listed in the ELECTRICAL WORLD for April 7 (page 726), will be presented when the regional meeting of the American Institute of Electrical Engineers meets at New Haven next month, there will be a symposium on surge measurements and protective devices. This will be held on the opening morning, Wednesday, May 9, and will include the following papers:

"Application of Relays for Protection of Power-System Interconnections," L. N. Crichton and H. C. Graves, Westinghouse Electric & Manufacturing Company.

"Application of Wound-Type Current Transformers to High-Voltage Circuit Breakers," J. C. Rea, Pacific Electric Manufacturing Company.

"Relation Between Transmission-Line and Transformer Insulation," W. W. Lewis, General Electric Company.

"Rationalization of Transmission-System Insulation Strength," Philip Sporn, American Gas & Electric Company.

"Hall High-Speed Recorder," C. I. Hall, General Electric Company.

"Pages from the Hall High-Speed Recorder," E. M. Tingley, Commonwealth Edison Company.

"Oscillograph Recording of Transmission-Line Disturbances," J. W. Legg, Westinghouse Electric & Manufacturing Company.

"High-Speed Graphic Voltmeter," A. F. Hamdi and H. D. Braley, New York Edison Company.

In the afternoon of Wednesday these papers are to be presented:

"Selection of Railway Motor Equipment by Principles of Similar Speed-Time Curves," B. A. Widell, General Electric Company.

"Shunting of Track Circuit in Polyphase Continuous Inductive Train Control," C. F. Estwick, General Railway Signal Company.

"The Diverter-Pole Generator," E. D. Smith, Jr., Rochester Electric Products Corporation.

"Electric Reduction in Hard Rubber, Pyrex, Glass, Fused and Crystalline Quartz," H. H. Race, Cornell University.

Another paper not previously noted will be given on Friday afternoon by L. A. Sheldon of the General Electric Company on the mercury boiler and turbine.

Competition for Los Angeles Ornamental Lighting

The Affiliated Improvement Associations of Los Angeles, representing 130 organizations, are urging the City Council to authorize competitive bidding for furnishing energy and maintenance for the ornamental lighting systems in the city. This service is paid for by annual direct assessments on property owners on the streets on which there are ornamental lighting posts. The assessments total more than $1,000,000 a year and are increasing as additional systems are installed.

A practical monopoly on this business is held by the Municipal Bureau of Power and Light through its political connections with the Board of Public Works. The Power Bureau charges 4 cents a kilowatt-hour. The Los Angeles Gas & Electric Corporation has offered the same service for 3 cents a kilowatt-hour.

Ferguson Against Federal Regulation of Utilities

Speaking on the utility question in its relation to politics, Samuel Ferguson, president of the Hartford (Conn.) Electric Light Company, declared Monday in an address before the national convention of the League of Women Voters at Chicago:

"I can raise no possible objection to being regulated by a fair-minded body, whether state or federal, provided that body could devote itself exclusively to regulating me according to local needs. But if in a rapidly changing industry rules and regulations necessary for my locality must also conform to the rules required by the vastly different conditions in California, Illinois or Maine, and be consistent all over the country, you can readily see that we shall be enmeshed in a hopeless snarl of red tape."

Congress can, by a very simple enactment, delegate its authority to the joint jurisdiction of the state utility commissions interested in particular interstate transactions, he said.

"One rather appealing fallacy," Mr. Ferguson observed in the course of his remarks, "has been indorsed by ex-Governor Pinchot and others, namely, that a fair return is one which will keep the company's securities at par, on the theory that this would be sufficient to make possible the obtaining of new capi-

tal when necessary for extensions. This is a policy of stagnation and high prices. If progress is to be rapid, capital must be anxious to be obtained and to be employed. To employ the maximum capital, growth must be as rapid as possible, and the only way to stimulate the maximum of growth is by a policy of minimum prices for the product sold."

Pointing out the fallacy of stressing fuel rather than distribution costs, indulged in by advocates of government operation at Muscle Shoals and Boulder Dam, Mr. Ferguson said that this undue prominence given to the smallest item of electrical costs distorted the picture.

Stevenson Creek Arch Dam Undergoes Severe Tests

Although no additional engineering tests have been made so far this year upon the experimental concrete arch dam on Stevenson Creek, in the mountains near Fresno, Cal., the Bureau of Standards, which has co-operated with the Engineering Foundation's committee of investigation in this enterprise, reports that the dam has undergone severe tests occasioned by floods. A flood which destroyed all the observation platforms and caused the choking of the undersluice filled the reservoir with rock, sand and silt to an average depth of about 40 ft. at the upstream face of the dam. With this débris against the dam the water filled the reservoir and at times rose to a height of about 3 ft. above the crest. During the winter just past the reservoir has been full, and a small amount of water has been running over the top of the dam. The only observed effects produced by unexpected pressure of débris and water have been a slight extension of the cracks near the bottom of the dam which occurred during a previous load test, the formation of an additional crack near the bottom and a small increase in the deflection of the dam.

The test has yielded results which give direct information on the temperatures in the concrete and on strains, stresses and deflections in the dam. The results also afford a basis for comparison with the stresses and deflections as computed by current methods of design. There was reasonably good agreement with the computed stress at approximately the mid-height of the dam, but at the top the agreement was poor. Results of tests of a celluloid model of the dam at Princeton University agree so well with the results from the actual structure that added confidence is felt in the use of models in designing arch dams. The Bureau of Reclamation is building at the University of Colorado, Boulder, a concrete model of the Stevenson Creek Dam, which will be tested for comparison with the Stevenson Creek Dam; also a model of the Gibson Dam, which is to be built in Montana and which will be about 900 ft. long and 165 ft. high.

The Stevenson Creek Dam is now 60 ft. in height. The Engineering Foundation plans to carry it higher.

Briefer News

DUKE POWER COMPANY BUILDS LINES INTO MARION, N. C.—The Duke Power Company has a large force of men working on a 100,000-volt power line that is being brought from its Bridgewater plant at Lake James into Marion, N. C., to furnish power for textile plants. Five acres of land just outside the city will be used for a substation, which is to be erected soon.

WISCONSIN UTILITIES ASSOCIATION ELECTS OFFICERS.—The annual election of officers for the Wisconsin Utilities Association, which is conducted by mail ballot, was held last week and resulted as follows: President, C. R. Phenicie, Green Bay, vice-president Wisconsin Public Service Corporation; vice-president, D. E. Callender, Racine; treasurer, Ewald Haase, Milwaukee; publicity director, M. H. Frank, Fond du Lac; assistant publicity director, E. J. Steinberg, Milwaukee.

OREGON COMMISSION TO EVALUATE PORTLAND COMPANIES.—An order has been entered by the Oregon Public Service Commission for a rate-fixing valuation of all properties belonging to the Portland Electric Power Company and the Northwestern Electric Company, whose consolidation was forbidden at a recent special election. The commission thinks it probable that the present rates of the two companies are inconsistent with the rate base determined by the commission in 1916.

KANSAS CITY CHAMBER OF COMMERCE STARTS COURSES IN PUBLIC UTILITY ECONOMICS.—Under the auspices of the Kansas City Chamber of Commerce an evening course in public utility economics is being given at the Kansas City School of Commerce. It began on April 16 and will last for eight weeks, under the direction of Charles H. English. Special lectures on various phases of public utility administration will be given by experienced utility men, engineers and others, among them L. A. Pettit, Missouri Power & Light Company; C. C. Smith, A. E. Bettis, H. H. Kuhn and F. S. Dewey, Kansas City Power & Light Company, and S. B. Irelan, Henry L. Doherty & Company.

SOUTHWESTERN PUBLIC SERVICE ASSOCIATION MEETS IN DALLAS NEXT WEEK.—Increasing the domestic load, refrigeration, organizing for service to large power customers, safety methods, rural electrification and the selection and training of personnel are the topics selected for discussion at the Electric Section of the Southwestern Public Service Association, which will hold its thirty-third annual convention at Dallas from Wednesday to Saturday of next week. The Electric Section and the other sections will meet in the afternoons. The general sessions, in the mornings, will be addressed by executive heads of the national utility associations and other well-known men.

DECATUR RATE REDUCTION CONTINGENT ON INCREASE IN NUMBER OF CUSTOMERS.—The Illinois Power & Light Corporation has submitted to the Decatur City Council a proposal to establish an 8-cent, 6-cent and 3-cent rate to supplant the present charge of 9, 7 and 4 cents upon condition that the company obtains 17,000 patrons in the city with an average householder consumption of 400 kw.-hr. annually. The new tariff will be effective July 1 if this condition is met.

MONTREAL'S 66,000-VOLT UNDERGROUND CABLES.—Before the Montreal branch of the Engineering Institute of Canada on April 20 H. Milliken, chief engineer of the Montreal Light, Heat & Power Consolidated, described the city's new 66,000-volt underground cables and the new 4,000-volt distribution substation in the heart of the city. The cables, which extend about 4,000 ft. from the company's Vallée station to a double overhead 66,000-volt ring around the city, are, as so far installed, six in number, single-conductor, comprising two three-phase circuits. A third circuit will be installed soon, and eventually the present cable system will be duplicated and joined to the second ovehead ring.

GERING FARM PROJECT IN NEBRASKA STILL IN LITIGATION. — The district court at Gering, Neb., has upheld the legality of the recent act of the Legislature permitting rural communities to form districts for the purpose of purchasing electricity from municipalities and has dismissed the injunction that held up a recently called election. Nonresident landowners who asked for the injunction gave notice of appeal to the Supreme Court, which may tie the matter up for a year.

ERIE LIGHTING COMPANY'S NEW TURBINE.—A report just printed on the new 15,000-kw. turbine of the Erie (Pa.) Lighting Company, which went into operation about the beginning of the year, says that it exceeds efficiency specifications. This turbine, of General Electric manufacture, is the first fourteen-stage unit of its capacity to be designed and built by that company. It has doubled the previous capacity of the Erie plant, which is now one of the largest and most important base-load stations in the Pennsylvania division of the Associated Gas & Electric System. An 11,000-volt transmission line connects this plant with the Piney hydro-electric development on the Clarion River, which in turn is connected to the Seward steam station near Johnstown and the Deep Creek hydro plant in western Maryland.

VIRGINIA ELECTRIC & POWER COMPANY'S BUDGET.—Line extensions and connections, substations, improvements to distribution system and miscellaneous electrical items scheduled for completion in 1928 will cost the Virginia Electric & Power Company $2,500,000 or more.

Among these coming improvements are a 4,750-kw. substation at Norfolk, ornamental street lighting for Portsmouth, new equipment in various stations and substations, and an extension of transmission lines in northeastern North Carolina, $629,000 being appropriated for the last-named purpose.

SOUTHEASTERN WATER AND LIGHT ASSOCIATION MEETS AT ATLANTA.—The eighth annual meeting of the Southeastern Water and Light Association was held at Atlanta last week, representatives of municipal lighting plants and water departments predominating among the attendants as usual. New officers were elected as follows: President, R. B. Sims, Spartanburg, S. C.; vice-presidents, H. A. Lily, Badin, N. C.; W. W. Hunter, Augusta, Ga.; J. B. Farmer, Murfreesboro, Tenn., and J. F. Pearson, Orangeburg, S. C.; secretary, F. W. Chapman, Camden, S. C.

MODEL ELECTRICAL FARM WILL ADJOIN CHICAGO.—A model electrical farm of 80 acres is being developed by the Public Service Company of Northern Illinois a few miles out of Chicago. All of the buildings, including the farm home, will be built to specifications which include provision for all modern electrical applications. The house and barn will be wired according to "red seal" specifications. The farm will be operated by a practical farmer on a business basis in addition to being open for inspection and study. It is expected that it will be in complete operation early in the summer.

SAN FRANCISCO TO VOTE ON PUBLIC UTILITY COMMISSION ISSUE. — The Board of Supervisors of San Francisco has voted to place on the ballot at the primary election Aug. 28 a measure to permit voters of the city to decide whether they wish to create a public utility commission to administer and direct the water, light, power, heat and transportation utilities of the city. The measure was to have gone on the ballot at the next November general election. An attempt to change the provision fixing the commission at three members, and increasing it to a greater number, was decisively defeated at the board meeting.

FACT-FINDING POWER INVESTIGATION FOR MAINE.—The Maine section of the New England Council has appointed a fact-finding commission to investigate all phases of the power question as it affects that state. The commission is composed of William T. Cobb of Rockland, Philip Dana of Westbrook, James C. Boyd and Benjamin F. Cleaves of Portland, William I. Cummings of South Berwick, Leslie E. McIntire of Waterford and Robert J. Peabody of Lubec. The commission will not make recommendations, but the results of its inquiry will, it is expected, throw light on whether or not electrical energy should be sold for use outside the state.

WORK ON SLAVE FALLS PLANT ON WINNIPEG RIVER TO BEGIN SOON.—Preliminary development of the Slave Falls power site, on the Winnipeg River, in the Province of Manitoba, by the Winnipeg public hydro system will be begun soon, a year in advance of schedule, owing to the increased demand for electrical power from the city-owned utility. It is expected that development will be completed by 1931, at an estimated expenditure of $7,000,000. The Slave Falls site is 90 miles northeast of Winnipeg and 5 miles from the Pointe du Bois plant of the city hydro system. This is the last undeveloped power site on the Winnipeg River available to the public hydro enterprise. It will more than double the city's production of electrical energy and round out a twenty-five-million-dollar investment. There is available at the Slave Falls site a total of 36,480 continuous horsepower under conditions of ordinary minimum flow and more than 60,000 continuous horsepower at ordinary six-month flow. The head at this site is 26 ft.

Coming Meetings

[A complete directory of electrical associations, with their secretaries, is published in the first issue of every volume. For latest list see ELECTRICAL WORLD for Jan. 7, page 80.]

Southwestern Public Service Association—Dallas, Tex., May 2-5. E. N. Willis, 403 Slaughter Bldg., Dallas, Tex.

American Institute of Electrical Engineers—New Haven regional meeting, May 9-11; national convention, Cosmopolitan Hotel, Denver, June 25-29. F. L. Hutchinson, 33 West 39th St., New York.

Middle West Division, N. E. L. A.—Hotel Statler, St. Louis, May 9-11. T. A. Browne, 1519 O St., Lincoln, Neb.

Arkansas Utilities Association—Arlington Hotel, Hot Springs National Park, May 14-16. R. I. Brown, Arkansas Power & Light Co., Little Rock.

American Society of Mechanical Engineers—Pittsburgh, May 14-17. Calvin W. Rice, 29 West 39th St., New York.

Indiana Electric Light Association (jointly with Indiana Public Utilities Association) — Columbia Club, Indianapolis, May 22-24. William Stokes, 1548 Consolidated Bldg., Indianapolis.

National Electric Light Association—Atlantic City, June 4-8. P. S. Clapp, 420 Lexington Ave., New York.

American Association of Engineers—Hotel Hussman, El Paso, Tex., June 4-6. M. E. McIver, 63 E. Adams St., Chicago.

Electrical Supply Jobbers' Association—The Homestead, Hot Springs, Va., June 5-8. E. Donald Tolles, 165 Broadway, New York.

National Electrical Manufacturers' Association—The Homestead, Hot Springs, Va., June 11-15. S. N. Clarkson, 420 Lexington Ave., New York.

Pacific Coast Division, N.E.L.A.—Hotel Huntington, Pasadena, Cal., June 12-15. S. H. Taylor, 447 Sutter St., San Francisco.

Georgia Electrical Association—Savannah, June 14 and 15. J. J. McDonough, Georgia Power Co., Dublin, Ga.

Northwest Division, N.E.L.A.—Portland, Ore., June 19-22. B. Snow, 1208 Spalding Bldg., Portland, Ore.

Canadian Electrical Association—SS. "Richelieu" from Montreal to Saguenay and return, June 20-23. H. M. Lyster, 712 Power Bldg., Montreal.

American Society for Testing Materials—Chalfonte-Haddon Hall, Atlantic City, N. J., June 25-29. C. L. Warwick, 1315 Spruce Street, Philadelphia.

SAN DIEGO COMPANY MAKES RATE REDUCTIONS TOTALING $400,000 A YEAR.—Customers of the San Diego Consolidated Gas & Electric Company will benefit immediately to the extent of more than $400,000 a year as the result of reductions in electric and steam rates that went into effect on April 20. These new rates are based on an inquiry by the California Railroad Commission and the report of its engineering department that the company earning in 1927 was substantially $400,000 in excess of a net return of 7½ per cent on its investment, with which the company expressed itself content. The speedy conclusion of the case, with its substantial saving to the consumers, is believed to establish a record in the matter of quick handling of a formal rate matter of such importance. Reductions for the various classes of business are approximately as follows: Lighting, 11.4 per cent; general power, 11.1; agricultural power, 15.2; street lighting, 6.3; electric railway, 7.5; steam heating, 8.6.

OPTIONAL TARIFF FOR UPSTATE NEW YORK CUSTOMERS.—Optional rates for domestic consumers, offering a sliding-scale reduction with a minimum monthly rate of $3.50, are announced by the New York Central Electric Corporation, serving Perry, Auburn, Geneva, Hornell and many other communities in western New York. Under the optional schedule clients pay 10 cents per kilowatt-hour for the first 25 kw.-hr. a month, 8 cents for the second 25 kw.-hr., 6 cents for the third, 4 cents for the fourth and 3 cents for the remainder. The regular rate is 11 cents per kilowatt-hour for the first 50 kw.-hr., with corresponding reductions for quantity consumption. The minimum monthly rate is $1. The optional schedule is designed to encourage average consumers to use electrical household devices.

INTERCONNECTION GOES ON APACE IN TEXAS.—The installation of the new generating unit in the power plant of the Comal Power Company, at New Braunfels, Tex., to bring its capacity to 60,000 kw., will take about fourteen months and cost $2,000,000. Completion of the new installation will give the San Antonio Public Service Company a combined total of 100,000 kw. at New Braunfels and San Antonio. The San Antonio Public Service Company is interconnected with the Central Power & Light Company south of New Braunfels and with the Texas Power & Light Company, serving communities north of New Braunfels, and it is now constructing a line from New Braunfels to Luling to meet the Texas Power & Light system on the east. The Texas Power & Light Company is understood to plan the immediate construction of another 132,000-kw. line from its Trinidad station to a proposed new substation at

Milano Junction and a 60,000-kw. line from Milano Junction to Cameron. This will give that company a double transmission circuit into Temple. A 60,000-kw. line will run from Luling to Taylor and connect with the Insull lines by way of Seguin.

OSWEGO (N. Y.) HYDRO PLANT STARTS NEXT WEEK.—The hydro-electric plant at Oswego, N. Y., at Dam No. 6 on the Oswego River will be started on May 1. The plant has been constructed at a cost of approximately $1,000,000 by the Carlisle interests, which will operate it on a 25-year lease made a year ago, paying the city of Oswego in rent $50,000 a year. The plant will have a capacity of 7,500 hp., to be produced by three 2,500-hp. generators, with additional wheel pits for two more wheels, should the city at some future time obtain the right to develop the other one-half flow of the river, for which application has been made to the authorities at Albany.

SALT LAKE HAS SUCCESSFUL ELECTRICAL GATHERING.—The seventh annual convention and "get-together" of the representatives of the various branches of the electrical industry in Salt Lake City and adjacent territory was held on March 28, at the Newhouse Hotel, under the auspices of the Electrical League of Utah, and proved the most successful yet held. R. M. Bleak, president of the league; B. E. Rowley, former president; R. R. Reid, president of the local contractors and dealers' association; W. M. Scott, superintendent of lines and service of the Utah Power & Light Company's Salt Lake division; City Attorney William H. Folland of Salt Lake City, who discussed city ordinances; L. B. Gowan, of the Lighting Service Bureau; Clyde L. Chamblin, president of the Association of Electragists International, and Adam S. Bennion of the Utah Power & Light Company were speakers. About three hundred guests attended the dinner, at which George R. Randall was toastmaster.

IRELAND PLANS DISTRIBUTION OF SHANNON ENERGY.—In a report just issued by the Electricity Supply Board of the Irish Free State plans are outlined for the distribution of energy from the River Shannon, which will become available next year. A start will be made in Dublin, where the existing network will be used. The municipal undertaking will connect its transformer station with that which is being built by the Shannon board, and the work of switching over will present no difficulty. Cork and Limerick will be tackled almost immediately, while the board is negotiating for the acquisition of the authorized undertakings in Dundalk, Wexford and Clonmel. In the opinion of the board the interest of the country will be served best by the acquisition of all existing undertakings by the state. The board has mapped out an ambitious program for the electrification of 130 towns and villages in the Free State.

Recent Court Decisions

TO RECOVER FOR PERSONAL INJURIES ON SPECIFIC ALLEGATION OF NEGLIGENCE THERE MUST BE PROOF.—The Supreme Court of Iowa sustained a directed verdict for the defendant in Rauch vs. Des Moines Electric Company, a damage suit brought because the plaintiff, who had climbed upon one of the company's lighting poles to view a parade, was injured by the falling of a globe upon his head. He sued for compensation, claiming that the dislodgment of the globe was due to its being insecurely attached to its bracket; but the courts found the contention unproved and pointed out that a specific allegation of this nature does not come under the doctrine of *res ipsa loquitur* ("the thing speaks for itself.") (218 N. W. 340.)*

CHILDREN CANNOT CLIMB COMPANY'S POLES AT THE COMPANY'S RISK.—If parents permit their children to climb a public utility company's poles, they do so at their own risk, according to a decision of the Superior Court at Los Angeles. The ruling was made in connection with a damage suit for $75,000 brought by Harry K. Brown against the Southern California Edison Company because of the death of Brown's son, a boy of twelve, who climbed one of the defendant's poles and was killed. The court ruled: "With the development of electrical power and high-tension transmission lines it would be a dangerous precedent to relieve parents of responsibility and hold electrical distributing companies responsible for lack of knowledge or carelessness of a child of twelve which leads him to climb a pole which he ought to know was not put there for that purpose. To hold the companies liable would mean that they would be punished for the negligence of others."

COMPLAINT OF INTERFERENCE WITH STREAM BY UPPER RIPARIAN OWNER MUST ALLEGE UNREASONABLE USE OF WATER AS MATTER OF LAW.—The New York Supreme Court, Special Term, has dismissed the complaint in Maylender vs. Fulton County Gas & Electric Company, in which the company, as the upper riparian owner on Peck Creek, was charged with an unjustifiable interference with stream flow. Failure to allege that the company's works were not built in conformity with the fall of land, or were not adapted to the character of the stream, or were improperly operated, or that diversion of waters caused stream to overflow on plaintiff's land, or that plaintiff had ever used the waters of the stream or ever intended to do so, led, the court said, to the assumption that the dam was properly constructed and therefore that the lower riparian owner had no cause of action. (227 N. Y. S. 209.)

WHEN IS CONTRIBUTORY NEGLIGENCE A MATTER OF LAW?—Affirming a judgment for the plaintiff in Beman vs. Iowa Electric Company, a damage suit brought because of the death of plaintiff's husband from electric shock, the Supreme Court of Iowa said that the alleged contributory negligence was for the jury to pass on and that contributory negligence becomes a question of law, for the judge, only when it is so flagrant as to be evident to any reasonable person. In this case the man was one of a bridge crew working near a 13,200-volt transmission line belonging to the company. The company had been asked to move its line and had done so, but apparently not far enough, since, although fellow workmen gave evidence that they had tested the operation of the boom which the victim was guiding and found an 18-inch clearance between it and the electric wire, it was proved that death resulted as stated above. Proof that there had been no contact between the boom or cable of the derrick and the wire and testimony that electricity transmitted at 13,200 volts will not arc or jump over a gap from an unbroken continuous wire were not held by the court to substantiate the company's defense, the "thing speaking for itself." (218 N. W. 343.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

COMMISSION INSISTS THAT 95 PER CENT OF CONSUMERS IN SMALL COMMUNITY SHALL HAVE METERED SERVICE.—Meters are the best gage for determining what an electric consumer should pay for the service he receives, the North Dakota Board of Railroad Commissioners has held in the case of a complaint by citizens of Litchville against J. M. Haarsager, the operator of the electric light plant at that place. The petitioners asked for increased hours of electric service and reduction in the rate. The commission learned that some of the consumers had meters which they owned themselves while others received service at a flat rate. The company was directed to take over all meters within the next year and to put other consumers on a metered basis within 90 days, so that not more than 5 per cent of the consumers would remain on a flat-rate basis.

CONDEMNS DELAY IN APPLYING FOR CERTIFICATE UNTIL COMPETITION IS THREATENED.—In granting a certificate of public convenience and necessity to the Pacific Gas & Electric Company to operate a gas-distributing system in Irvington and contiguous territory and denying the application of the Alameda County Gas Company for a similar certificate, the California Railroad Commission reaffirmed its disapproval of a public utility waiting until threatened competition develops before making application to serve new territory. "A utility owes a duty to that portion of the public which seeks to obtain service as well as to that portion of the public which is already being served," the commission said. "In the case before us there is no question that the Pacific Gas & Electric Company made its offer of service only to forestall competition and filed its application for a certificate of public convenience and necessity only when forced to do so. For that reason it cannot urge a superior right to serve a territory which it has heretofore shown no disposition to enter. Much as the commission might look with favor upon the efforts of a new utility to develop an unserved territory, we are compelled in this instance, on account of the great disparity in rates and certain elements of financial ability, to grant the application of the Pacific Gas & Electric Company."

News About Men of the Industry

N. A. Carle Resigns

Nathaniel A. Carle, vice-president in charge of operations of the Public Service Production Company, Newark, N. J., has resigned. He is planning to make a trip to Leland Stanford University in California, of which institution he is a trustee, returning East in three months. For a number of years Mr. Carle has been an outstanding figure in the electrical industry, not only as an executive of one of the largest electric utilities in the country but also as a leader in the work of the national engineering organizations. He became identified with the Newark properties in 1912 as chief engineer of the Public Service Electric Company, in this capacity reorganizing and enlarging the engineering staff with noteworthy results along both technical and economic lines. In 1922, when the Public Service Production Company was organized, he became vice-president and general manager and two years later he was named vice-president in charge of operations.

N. A. Carle

Mr. Carle was born in Portland, Ore., and was graduated from Leland Stanford University. His early engineering activities carried him to Alaska, Canada, New England, Colorado and New York. Mr. Carle has given unstintingly of his time and energy to association affairs, having been an indefatigable worker as chairman and member of numerous committees. He is past-chairman of the Technical National Section of the National Electric Light Association, a fellow and a past-vice-president of the American Institute of Electrical Engineers and is active in the American Society of Mechanical Engineers, the Association of Edison Electric Illuminating Companies, the Institute of Radio Engineers and the American Electric Railway Association.

O. W. MATTISON, formerly manager of the Missouri Power & Light Company in the Mexico district, is now in charge of the Dakota properties of the United Public Service Company with headquarters in Bismarck, N. D. PAUL C. EKERN of Brookfield will succeed Mr. Mattison in Mexico and J. F. DUNCAN of Edina will succeed Mr. Ekern in Brookfield.

HUEY P. LONG, a member of the Public Service Commission of Louisiana, has been elected Governor of that state on the Democratic ticket. Mr. Long was elected a member of the Railroad Commission of Louisiana in 1918, serving on that body until the Louisiana Public Service Commission was created in 1921, when he became a member of that commission. Three years later he was elected to a six-year term.

BANCROFT GHERARDI, chief engineer of the American Telephone & Telegraph Company and president of the American Institute of Electrical Engineers, and Jacob F. Schoellkopf, chairman of the board of directors of the Buffalo, Niagara & Eastern Power Corporation, Buffalo, N. Y., have been nominated to fill two vacancies on the board of trustees of Cornell University. The vacancies will occur in June, when the terms of John L. Senior of Chicago and Judge Cuthbert W. Pound of Lockport, N. Y., will have expired.

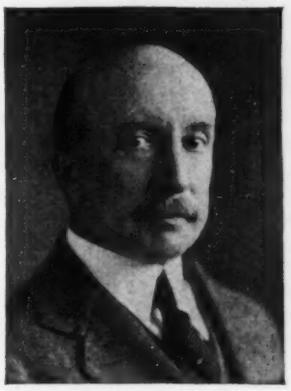
ROBERT L. FITZGERALD, manager of the light and power department of the Indiana Service Corporation, Fort Wayne, Ind., since 1924, has resigned his position with that company, effective April 30. Mr. Fitzgerald plans to enter business with B. O. Fink and Jack Fulton in the Auburn Stoker Corporation, Auburn, Ind., manufacturing and marketing automatic smokeless coal burners for heating and industrial boilers. He was formerly associated with the Gary (Ind.) Heat, Light & Water Company, the engineering staff of the Wisconsin Railroad and Tax Commission and with R. M. Feustel, consulting engineer.

ELMER A. SPERRY, inventor and engineer, has been awarded the Holley medal by the American Society of Mechanical Engineers for his achievements in the invention of the gyroscope. Frequent recognition has been given Mr. Sperry for his engineering accomplishments in the form of honorary degrees, medals and membership in scientific societies. In the course of his distinguished career he has been the recipient of the John Scott legacy medal and premium, the John Fritz medal, the Franklin medal and the American Museum of Safety medal. Mr. Sperry was decorated by Czar Nicholas II of Russia for navigational equipment and he received the Order of the Rising Sun from the Emperor of Japan in 1922. Presentation of the Holley medal will be made May 16 at a dinner which is to be held during the spring meeting of the American Society of Mechanical Engineers in Pittsburgh.

Theodore Beran Retires

Theodore Beran, commercial vice-president of the General Electric Company in charge of the New York district, has asked to be relieved of the responsibilities of his office May 1, having voluntarily decided to retire from active business life. In commenting on Mr. Beran's retirement J. G. Barry, vice-president of the company, said: "During his long and valuable service, extending over a period of more than 39 years, he has devoted himself wholeheartedly to the company's interests in building up its business in the important territory of which he was the principal commercial executive."

Mr. Beran was born in Springfield, Mass., and was educated in the public schools of New York City, later receiving an A.B. degree from the College of the City of New York. He joined the Sprague Electric Railway & Motor Company in New York in 1889 and when that company consolidated with the Edison interests in 1890 he continued with the Edison General Electric Company and with the General Electric when it was formed in 1892 from the consolidation of the Edison and Thomson-Houston interests. In 1904 he removed to Rugby, England, where he organized the commercial department of the British Thomson-Houston Company. In the fall of 1903 he was made acting manager of the New York district for the General Electric Company, a year later being designated district manager. It was in 1926 that he was named commercial vice-president. Mr. Beran is an associate member of the American Institute of Electrical Engineers, vice-president of the Electrical Board of Trade and a past-president of the New York Electrical Society.



Theodore Beran

L. J. EDMONSTON, representing the Missouri Power & Light Company at Plattsburg, Mo., has been appointed manager of the Edina office.

S. E. Wolff Removes to Oklahoma

Samuel E. Wolff, consulting engineer, of New York, has disposed of his utility interests in the East to become president of the Oklahoma Power & Water Company, organized by the Colvin interests, with headquarters in Sand Springs. Mr. Wolff has had many years experience in public utility operation in the East and in the Middle West, particularly in Michigan, where he was born and where he was identified with the properties now new

S. E. Wolff

constituent units of the Consumers Power Company. After serving in various departments he resigned as general manager of the Jackson (Mich.) Gas Company to take a similar position in charge of the gas, electric and railway utilities in Saginaw and Bay City, Mich. In 1908 he joined the New York executive staff of Hodenpyl, Hardy & Company, managers of the Michigan properties, and continued in the discharge of various functions for them until the end of 1921, when he engaged in some industrial work for a group of New York bankers. Recently he has operated properties in the East and has done financial and consulting work with offices in New York City. Mr. Wolff is a past-president of the Michigan Gas Association, a member of the American Gas Association and of the National Electric Light Association, the insurance committee of which he organized several years ago.

HERMAN HILL, for many years consulting electrical and mechanical engineer, is now identified with the Perfection Appliance Company, a subsidiary of the Splitdorf-Bethlehem Electrical Company. Mr. Hill is a practical inventor, his patents totaling more than one thousand.

FRANK J. DOYLE, chief engineer of the Northern States Power Company at St. Cloud, Minn., for 3½ years, has been transferred to Sioux Falls, S. D., to manage the plant there operated by the Northern States company. He was assistant chief at Sioux Falls for 6½ years before removing to St. Cloud. Succeeding Mr. Doyle at St. Cloud as chief engineer will be L. H. Lawrence of Sioux Falls.

T. F. BOWDERN is now head of the public relations department of the Arkansas-Missouri Power Company, the East Missouri Power Company and the Missouri Public Service Company, all controlled by the Inland Power & Light Company.

Moloney and Mullen of St. Louis Resign

T. O. Moloney and James J. Mullen have resigned as president and vice-president of the Moloney Electric Company, St. Louis, Mo., effective June 30, to devote more time to their personal affairs. During the 30 years in which they have been connected with the company it has grown to be one of the largest transformer manufacturers in the United States with unusually well-equipped factories, having recently completed a large plant in the industrial district of St. Louis. Mr. Moloney and Mr. Mullen will continue as members of the board of directors and in an advisory capacity. F. H. Barrington will be in active charge of the management of the company, assisted by W. M. Cory, both of whom are identified with the company at the present time.

Mr. Moloney's activity in the electrical industry dates back to 1890, when he became connected with the electrical department of the Laclede Gas Light Company of St. Louis. The existing type of transformer engaged his special attention and through these studies he quickly obtained the experience which enabled him to contribute substantially to the evolution of the modern, well-balanced transformer. From these beginnings resulted the Moloney Electric Company, organized in 1897 with Mr. Moloney as president.

H. D. Savage Heads Combustion Engineering

H. D. Savage, for many years vice-president of the Combustion Engineering Corporation, New York, has been elected president to succeed Joseph V. Santry, resigned. Mr. Savage brings to his new office a long and varied experience in the manufacture and sale of power plant equipment. He has been identified with the development of pulverized fuel-burning equipment since its very inception and is recognized as an authority on this subject. When the

H. D. Savage

Combustion Engineering Corporation purchased the Lopulco Pulverized Fuel Systems, in 1920, Mr. Savage became associated with this organization as the directing head of the pulverized fuel division. In addition to the presidency of the Combustion Engineering Corporation Mr. Savage holds executive positions in a number of the subsidiary companies of the corporation. He is a member of the American Society of Mechanical Engineers, American Society of Mining and Metallurgical Engineers and of the Franklin Institute.

Obituary

HOWARD F. THURBER, formerly president of the New York Telephone Company, died at his home in New York April 21 of pneumonia. Mr. Thurber was made chief executive of the telephone company in 1919 after spending practically his entire business life in the service of Eastern telephone companies. He occupied the office of president for five years and subsequently became chairman of the board of directors. Mr. Thurber was a native of Brooklyn, N. Y., and received his technical training at the Brooklyn Polytechnic Institute and at Cornell University. He was a member of the A.I.E.E.

ELIAS E. RIES, engineer-inventor, died of pneumonia at his home in New York April 20 after an illness of one week. Mr. Ries was prominently identified with the very beginnings and with the development of electrified railroads and rapid transit in New York and other cities. He was also a pioneer in the electric light industry in New York, from 1880 to 1884, having been affiliated with S. Bergmann & Company, the Edison company, the U. S. Electric Illuminating Company and with the Fuller Manufacturing Company.

ALEXANDER D. LUNT, manager of the patent department of the General Electric Company since 1922, died in Atlantic City, N. J., April 25. He had been ill since December. A native of Biddeford, Me., Mr. Lunt received his technical education at Worcester Polytechnic Institute and at Cornell University. Previous to joining the General Electric patent department in 1898 he was connected with the United States Patent Office at Washington.

Financial and Statistical News

Common Stocks Rise Steadily Refunding Program Large

THE investor who has had sufficient foresight to add a sprinkling of utility common stocks to his holdings during the past few months has been amply repaid, assuming, of course, a reasonable degree of diversification. It would be difficult to pick a group of power and light stocks in which a handsome appreciation has not taken place, even since the beginning of the current year. A representative group of fifteen leading stocks averages 142 at present, against 122 at the first of the year. The same group averaged 95 at the beginning of last year. Among the individual members of the group gains of as much as 45 points were made since the beginning of this year. The market continues exceedingly strong.

Refunding and retiring of high-priced issues continues on a large scale. More than $116,000,000 of power and light company bonds were called in April. A large number of these were 6s and 7s. According to predictions, bond redemptions for May will be unusually heavy in the power and light industry. Several large issues will be replaced with money costing anywhere from ½ per cent to 2 per cent less and annual charges will thus be materially reduced.

America Financing Big British Electricity Trust

Will the supply of electricity for lighting and power purposes in southern England (excluding London) eventually come under the control of one great trust supported and financed by American capital? This question is becoming one of great interest in British electrical circles at the present time. As straws indicate the direction of the wind, so it is thought do the many facts available indicate the trend of events.

The keynote of the situation is declared to be the Greater London and Counties Trust, Ltd., which is said to have behind it practically unlimited American capital. Already this trust has a controlling interest in the East Anglian Electricity Company, the Oxford Electric Company and Edmundsons' Electricity Corporation, Ltd. It will also control the Bedfordshire, Cambridgeshire and Huntingdonshire Company, which is not yet operating, but owns bulk supply powers within the area embraced by its title, and the Wessex Electricity Company. This, again, is not yet operating, but holds bulk supply powers within the counties of Oxford, Buckinghamshire, Berkshire, Wiltshire and Gloucestershire. It is also promoting a bill in Parliament to increase its area by including, *inter alia*, Devon and Cornwall.

How much farther the operations of the trust will extend cannot be stated at present. All that is known is that during recent months there has been a persistent purchasing of the shares of bulk supply and distributing companies in southern England at prices which have little regard for present dividends.

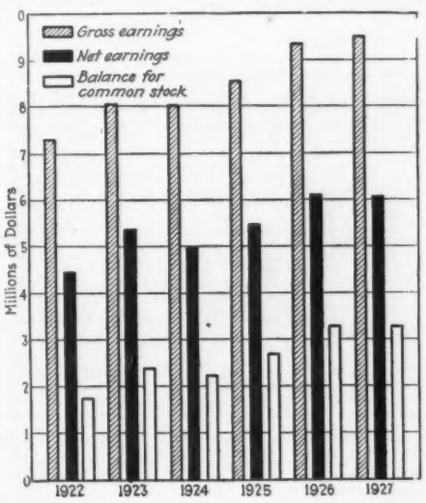
The latest development is the notification of the Sevenoaks Electricity Company of an offer to purchase its entire issued capital. No indication is given as to the identity of the potential purchaser, but shareholders have been advised not to part with their holdings. It is worth noting that the area in which the company operates is within the bulk supply area of one of the associated companies of the County of London Electric Supply Company.

Virginia Electric Plans New Issues

To care for possible future financial requirements the directors of the Virginia Electric & Power Company have been authorized to issue, in their discretion, $8,000,000 in first and refunding mortgage gold bonds of the company, which will increase the aggregate to $20,000,000. This action was taken at the annual meeting of the stockholders. The directors also were authorized to petition the State Corporation Commission to permit amendment of the company's charter so as to provide for an increase of $5,000,000 in 6 per cent cumulative authorized preferred stock. Possibly $3,000,000 in 6 per cent preferred will be issued this year.

Montana Power Gross Earnings Advance Slightly Over 1926

AS A result of curtailment of copper production last year the Montana Power Company, showed an increase of only 2 per cent in gross and an actual decline in net earnings as well as in surplus over charges. Completion of an electrolytic zinc plant by the Anaconda Copper Mining Company, however, is expected to add $750,000 to income yearly. Furthermore, important economies are expected to result from merger with the American Power & Light Company, on which plan the shareholders are asked to pass this week.



Earnings of Montana Power Company covering six-year period

	1926	1927
Gross earnings	$9,339,189	$9,518,728
Operating expense	3,208,551	3,437,638
Net earnings	$6,130,638	$6,081,090
Interest	1,826,610	2,168,387
Surplus	$4,304,028	$3,912,703
Depreciation	350,000	300,000
Balance	$3,954,028	$3,612,703
Preferred dividend	684,922	342,461
For common	$3,269,106	$3,270,242

The generating capacity of the Montana Power system now stands at 245,000 kw., 18,000 kw. having been added during the year. The year's output totaled 1,366,997,834 kw.-hr., which is approximately the same as the 1926 figure. The yearly load factor was 81.5 per cent and the company served 49,844 customers, an increase of 2,220.

Earning figures of the company for the past two years were as shown in the accompanying table.

Utility Financing Active

During the week ended April 26 new offerings by the electric light and power companies of the country totaled approximately $58,000,000. One of the largest issues of that type brought out during the year was offered by Cities Service Company in the form of 5 per cent gold debentures, a piece of financing involving a total of $50,000,000. These securities were priced at 98 and interest to yield 5.13 per cent.

The Railway & Light Securities Company offered 4½ per cent collateral trust gold bonds to the amount of $3,000,000, the price being 94¼ and interest, to yield about 4.90 per cent. These bonds, due May 1, 1953, are a direct obligation of the company, which was organized for the purpose of holding for income or sale the securities of public utility enterprises.

Six per cent cumulative preferred stock of the Iowa Power & Light Company was issued to the amount of $1,000,000 at $100 per share and accrued dividend.

The American European Securities

Company made two new offerings, one in the form of collateral trust 30-year sinking fund 5 per cent gold bonds, amounting to $2,000,000, and the other in the form of common stock of no par value, totaling 30,000 shares. The company was organized in 1925, under the laws of the State of Delaware, to take over the assets and business of the Investment Company for Electrical Enterprises in the United States, a Swiss corporation established in 1910.

WORTHINGTON PUMP ELECTS NEW DIRECTORS.—E. T. Fishick and W. C. Stettenius have been elected members of the board of directors of the Worthington Pump & Machinery Corporation.

NATIONAL POWER & LIGHT INCREASES COMMON DIVIDEND. — The National Power & Light Company declared a quarterly dividend of 25 cents on the common, placing the stock on a dollar annual basis, against 80 cents previously. Initial quarterly dividend of $1.50 was also declared on the $6 preferred. The common dividend is payable June 1 to stock of record May 15 and the preferred May 1 to stock of record April 24.

General Electric Sales Billed Down Slightly for Quarter

Sales billed by the General Electric Company for the first quarter of 1928 were $71,640,790, against $72,474,474 for the first quarter of 1927. Profit available for dividends on common, however, was $11,261,842, against $11,028,143. The comparative statement for the first quarter of the two years is given in the following table:

	1928	1927
Net sales billed	$71,640,790	$72,474,474
Less costs	63,404,807	63,641,300
Net income from sales	$8,235,982	$8,833,173
Other income, less interest paid and sundry charges	3,669,504	2,838,557
Profit available for dividends	$11,905,487	$11,671,731
Less: Cash dividends on special stock	643,644	643,587
Profit available for dividends on common stock	$11,261,842	$11,028,143

Utility Bonds Called in April Total $116,846,830

Among the electric light and power securities called for payment in April in advance of maturity are the following:

Issue	Due	Amount
Public Service Elec. & Gas, 5½s	1959	$25,379,000
National Public Service, 6½s	1955	15,635,000
Continental Gas & Electric, 6½s	1964	11,700,000
Cincinnati Gas & Electric, 5s	1956	8,224,000
Cincinnati Gas & Electric, 5½s	1961	5,810,000
Birmingham Electric, 6s	1954	8,000,000
Pennsylvania Edison, 5s	1946	6,355,600
Shawinigan Water & Power, 5s	1955	5,957,000
Shawinigan Water & Power, 5½s	1954	1,500,000
Pennsylvania C. L. & P. 5½s	1975	5,500,000
Pennsylvania C. L. & P. 5s	1950	2,191,000
Utah Power & Light, 6s	1944	5,500,000
Indiana Service, 6s	2020	4,795,530
York Haven Water & Power, 5s	1957	2,390,000
Metropolitan Edison, 5s	1939	2,348,000
Memphis Power & Light, 6s	1948	2,000,000
Electrical Securities, 5s	1955	1,000,000
United Electric Securities, 5s	1956	1,000,000
Central Illinois Utilities, 6s	1932	766,000
Kingsport Utilities, Inc., 6s	1937	456,000
Kingsport Utilities, Inc., 7s	1937	150,000
Erie County Electric, 5½s*	1960	137,000
Potomac Electric Power, 6s*	1953	52,700

* Not entire issues.

GERMAN UTILITY TO REDEEM BONDS. —The Westphalia United Electric Power Corporation will redeem at par and

Stock Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday April 24	Low 1928	High 1928
ABITIBI PWR. & PAPER, com., new — no par	78	72	81
Ala. Pwr., $7 cum. pf.—no par	115	114	116
Allis-Chalmers Mfg., 6% com., ex.div.	121½	115½	127
Aluminum Co. of Amer., com.	145	120	150
Aluminum Co. of Amer., 6% pf.	109½	105½	109½
Amer & Foreign Pwr., 7% pf.—no par	109	105½	109½
Amer. & Foreign Pwr., com.—no par	30	22½	32
Amer. Bosch Magneto, com.—no par	24½	15½	28½
Amer. Brown Boveri Elec.†	13½	10½	18
Amer. Brown Boveri Elec., pf. $7	50	46½	63
Amer. Gas & Elec., 6% pf.—no par	109½	106½	109½
Amer. Gas & Elec., com. †—no par	144½	117½	154
Amer. Lt. & Trac., 6% pf.	118	116	120
Amer. Lt. & Trac., new com.	211	170	220
Amer. Pwr. & Lt., 6% pf.	107½	104	109½
Amer. Pwr. & Lt., com. †—no par	81	62½	85½
Amer. Pub. Serv., 7% pf.	99	99	100
Amer. Pub. Serv., com. †	k 70	70	75
Amer. Pub. Utilities, 7% ptc. pf.	a 97	87½	96½
Amer. Pub. Utilities, 7% pr. pf.	a101	95½	101½
Amer. Pub. Utilities, com.	k 60	60	65
Amer. States Sec., A	a 11½	4	12½
Amer. States Sec., B	a 15½	4½	16½
Amer. Superpwr., 6% 1st pf.	l 103	....	....
Amer. Super pwr., Class A†—no par	50½	37	51½
Amer. Super pwr., Class B†—no par	53½	37½	53½
Amer. Wtr. Wks. & Elec., 6% pf.	105½	101½	106
Amer. W.W. & E., com. new—no par	60½	52½	64½
Anaconda Copper cap. $3	67½	53½	72½
Appalachian Electric Pwr., 7% pf.	108	108½	110
Arkansas Pwr. & Lt. 7% pf.	107½	108	109½
Assoc. Gas & Elec., $3.50—50	54½	....	....
Assoc. Gas & Elec., pf.—$6—no par	96	96	98½
Assoc. G. & E., Class A, 10—no par.	48½	47	51½
BABCOCK & WILCOX, 7% com.	118	117½	124½
Binghamton L., H. & P., $6 pf.	108	102	108½
Birmingham Elec., pf.—$6—no par.	106	104	105½
Blackstone Valley G. & E., 6% pf.	k106	106	112
Blackstone Valley Gas & Elec., 10% com.—50	k165	135	170
Blaw-Knox, com.†	d101	91	105
Brazilian Trac., Lt. & Pwr., $7 com.	f234	....	....
Brazilian Trac., Lt. & Pwr., com., new	f 58½	....	....
Broad River Pwr., 7% pf.	105	105	108
Brooklyn Edison, 8% com.	249½	206½	268½
Buffalo, Niagara & East. Pwr., $1.60 pf.—25	k 26½	....	..
Buffalo, Niagara & East. Pwr. com. $1.20—no par.	k 41½	....	....
CALIFORNIA ELEC. GENERATING, 6% pf.	99½	98	101
California Ry. & Pwr., 7% pf.	135	....	....
Carolina Pwr. & Lt., pf.—$7—no par	l111	109	110½
Central & S. W. Util., $7 pf.—no par	a104½	99½	105½
Central & S. W. Util., pr. ln. $7 pf.—no par	a110	103½	110
Central Ark. Ry. & Lt., 7% pf.	105½	105	107
Central Ill. Pub. Serv., $6 pf.	a 99½	97½	100½
Central Ind. Pwr., 7% pf.	a100	95	100
Central Maine Power, 6% pf.	98	96	98
Central Maine Power, 7%	110	109	112
Central Pwr. & Lt., 7% pf.	109	104½	105½
Central States Elec., 7% pf.	117½	104½	119½
Century Elec., 6% com.	m135	135	145
Cincinnati Gas & Elec., 5% com.	e 99½	97½	100½
Cities Service, $6 pf.—no par	l 102½	94½	100
Cities Service, pf. B—no par	l 9½	8½	9½
Cities Service, pf. BB—no par	k 95	88½	95
Cities Service com.—20	k 59½	54	59½
Cities Service, Bks. Shrs.—10	l29½	26½	29½
Cities Service Pwr. & Lt., 7% pf.	109	105½	109
Cities Service Pwr. & Lt., 6% pf.	100½	95½	101½
Cleveland Elec. Illg., 6% pf.	113	113	115½
Cleveland Elec. Illg., 10% com.	410	350	410
Columbia Gas & Elec., 6% pf.	108½	107½	110½
Columbia G. & E. com. $5—no par.	101½	89½	106½
Columbus Elec. & Pwr., $2 com.—no par.	k 77½	66	79
Columbus Elec. & Pwr., 7%	112	....	....
Columbus Ry., Pwr. & Lt., 7%	110	....	....
Columbus Ry., Pwr. & Lt., 7 % pf. B	110	....	....
Columbus Ry., P.& I t. com.—no par	120	....	....
Commonwealth Edison, 8% com.	a182	165	189
Commonwealth Pwr., 6% pf.	103½	102½	104½
Commonw'th Pwr., $2, com.—no par	79½	62½	86½
Conn. Lt. & Pwr., 8% pf.	121	120	125
Conn. Lt. & Pwr., 7% pf.	117	118	121
Cons. Gas of N. Y., pf.	104	101½	105
Cons. Gas of N. Y., com. $5—no par.	150	119½	156½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6% pf.	e111½	110	113
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6½% pf.	m111½	110½	114½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 5% pf.	e104½	100½	105½
Cons. Gas, Elec. Lt. & Pwr. of Balti., com. $3.00—no par.	e 81½	67½	82
Consolidated Pwr. & Lt., 7% pf.	105	....	....
Consumers Pwr., 6% pf.	104½	105½	106½
Consumers Pwr., 6.6% pf.	105	106	107
Continental Gas & Elec., 7% pr. pf.	108	106½	108½
Conti. G. & E. com. $4.40—no par.	k230	240	265
Crocker Wheeler, com.†	40	23	46
Crocker Wheeler, 7% pf.	90	77	95
DALLAS PWR. & LT., 7% pf.	110	110	111½
Dayton Pwr. & Lt., 6% pf.	108½	108½	109½
Derby Gas & Elec., 7% pf.	102	96	100½
Detroit Edison, 8% com.	188	166½	194½
Dubilier Condenser, com.—no par.	4½	2½	5½
Duke Pwr., cap.	k143	130	145
EASTERN NEW YORK UTIL., $7 pf.	k110½	111	112½
Eastern States Pwr. B	k 21	12	22
Eastern States Pwr., pf.	k 99	98	100½
East. Tex. Elec., 7% pf.	107½	106	109
Edison Elec. of Boston, $12 com.	d276	252	284½
El Paso Elec. 7% pf.	110	110	112½
Elec. Bond & Share, 6% pf.	l110½	108½	111½
Elec. Bd. & Sh. Sec., com. $1—no par	l119	76	127½
Electric Household Util.†	a 21½	13½	24
Elec. Investors, 6% pf.—no par.	104	101	103½
Elec. Investors, com.†—no par.	58	40½	60½
Elec. Pwr. & Lt., ctfs. pf.	109½	106½	110½
Elec. Pwr. & Lt., ctfs., 40% pd.	127	120½	129½
Elec. Pwr. & Lt., ctfs., com.—no par	41½	28½	44½
Elec. Ry. Securities, com.—no par.	7	....	....
Elec. St. Battery com. $5.25—no par	79½	69	83½
Elmira Wtr., Lt. & R.R., 7% pf.	106½	104	107
Empire Pwr., pfc.†	34½	27½	35½
Engr. Pub. Serv. $7, pf.—no par.	110½	107	110½
Engr. Pub. Serv., com.—no par.	40	33	42½
Eureka Vacuum Cleaner, com. $4—no par.	75	69	79
FAIRBANKS MORSE, 7% pf.	k109½	104	110
F.-M., com.—$3—no par.	51½	32½	54
Federal Lt. & Trac., com $1.40.	53½	42	56½
Federal Lt. & Trac., $6 pf.—no par.	k108½	98	109
Florida Pwr. & Lt., 7% pf.	k108	105	108
Ft. Worth Pwr. & Lt., 7% pf.	l114	113	114½
GALVESTON-HOUSTON ELEC. 6% pf.	82	75	85
Galveston-Houston Elec., com.	34	31½	38
General Cable, Cl. A	73½	56	84½
Gen. Elec. $3 com.—no par.	164	124	174½
Gen. Elec., special—6%	11½	11½	11½
Gen. Gas & Elec. (Del.) com A $1.50—no par.	41	35½	44½
Gen. G. & E. (Del.) pf. A $8—no par	k142	125	144
Gen. G. & E. (Del.) pf. A $7—no par.	124	110	120
Gen. G. & E. (Del.) pf. B $7.	115	104	117
Gen. Pub. Serv., $7 cum. pf., no par.	117	110	120
Gen. Pub. Serv., com., no par.	21½	16½	22½
General Public Utilities, $7 pf.	k 58	55	65
Ga. Lt., Pwr. & Rys., com.	k 58	55	65
Gt. Western Pwr., 7% pf.	h105	....	....
IDAHO PWR., 7% pf.	110½	109	110½
Ill. No. Utilities, 6% pf.	a100	....	....
Ill. Pwr. & Lt., 7% pf.	105½	103	107
Indianapolis Pwr. & Lt., 6½% pf.	k105½	102	107½
Indianapolis Pwr. & Lt., $7 pf.	k103	100	105
Ingersoll Rand com.	98	90	98
Int. Combus. Engr., com. $2—no par	50	45½	55½
Int. Combustion Engr., 7% pf.	104	103	106½
Int. Util., Class A—$3.50—no par.	49	44½	51
Int. Utilities, Class B—no par.	11½	6½	11½
Interstate Pwr., pf.—$7—no par.	103	99	103½
Interstate Pub. Serv., 7% pf.	104	103	106½
Iowa Ry. & Lt., 7% pf.	101	102	103
JERSEY CENTRAL PWR. & LT. CO., 7% pf.	107½	105	107
Johns-Manville, com.†—no par.	124½	111½	133½
Johns-Manville, 7% pf.	m122½	119½	121½

Stock Exchange: aChicago; bSt. Louis; cPhiladelphia; dBoston; eBaltimore; fMontreal; gCincinnati; hSan Francisco; iPittsburgh; jWashington. kBid price Saturday, April 21. lBid price Wednesday, April 25. mLatest quotations available. †Dividend rate variable.

Stock Quotations of Electric Light and Power and Manufacturing Companies (Continued)

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday April 24	Low 1928	High 1928
KANSAS GAS & ELEC. 7% pf.	l110	107	110
Kelvinator Corp.	21½	11½	22½
Kentucky Hydro-Elec., 7% pf.	m104½	102	104½
Kentucky Sec., 6% pf.	92	94	98
Kentucky Sec., 5% com.	150	140	150
Kentucky Utilities, 6% pf.	104½	100	105
LACLEDE GAS LT., 10% com.	k200	200	260
Lehigh Pwr. Sec., com.—no par	29	19½	32½
Long Island Ltg., 7% pf.	k110½	110½	112½
Long Island Ltg., 6% pf.	k108½	107	109
Long Island Ltg., com.†—no par	k177	170	185
Los Angeles Gas & Elec., 6% pf.	k111½	105	112
Louisville Gas & Elec., cl. A, $1.75	36	28	36
MAN. ELEC. SUPPLY, cap. $5—no par	53	50	61
Maytag Co., com. 50—no par	38½	30	39½
Memphis P. & L., pf.—$7—no par	111	109	111
Metropolitan Ed., pf.—$6—no par	109	103	109½
Metropolitan Ed., pf.—$7—no par	109½	109	111
Metropolitan Ed., com. $5—no par	k160	125	155
Middle West Utilities, 6% pf.	a 99	93½	100
Middle West Util., 6% pr. lien	a107	99	107
Middle West Util., com. $6—no par	a141½	123½	143
Midland Utilities, pr. ln. 6% pf.	a 95½	94½	97
Midland Utilities, 6% pf. A	a 90½	89½	92½
Milwaukee Elec. Ry. & Lt., 7% pf.	105	100	106
Milwaukee Elec. Ry. & Lt., 6% pf.	105	98	107
Minn. Pwr. & Lt., 7% pf.	l108½	107	109
Miss. River Pwr., 6% pf.	k108	94	109½
Miss. River Pwr., 3% com.	110	....	....
Mohawk Hudson Pwr., 1st pf.—$7—no par	k106	100	110
Mohawk Hudson Pwr., 2d pf.—$7—no par	k104	100	109
Mohawk Hudson Pwr., com.—no par	39	29½	40
Montana Pwr., 5% com.	165	102½	169½
Montreal Pwr., 7½% com.	f 97½	....	....
Mountain States Pwr., 7% pf.	k104	97	105
Mountain States Pwr., com.†	17½	....	....
NASSAU & SUFFOLK LTG., 7% pf.	110	98	110½
National Carbon, 8% pf.	a138½	138	139½
National Elec. Pwr., A†	a 31½	27½	32½
National Lt., Ht. & Pwr., com.	k 24	20	30
National Light, Ht. & Pwr., 5% pf.	72	70	80
National Pwr. & Lt., pf.—$7—no par	109	....	....
National Pwr. & Lt., com.†—no par	31	21½	33½
National Pub. Serv., 7% pf.	102	99	103
National Pub. Serv., 7% pfc., pf.	114	....	....
National Pub. Serv., A com. $1.60—no par	25½	22	27½
National Pub. Serv., B com.—no par	k 28½	24½	30
Nebraska Pwr., 7% pf.	l111	110	111½
Nevada-Calif. Elec., com.	35½	33½	42
New Brunswick Pwr., 4% pf.	62	60	70
New Eng. Pub. Serv., pr. ln. pf. $7	105	105	109½
New Eng. Pub. Serv., pf. $7	107	95	108
New Orleans Pub. Serv.—7% pf.	108	106	110
N. Y. & Queens Elec. Lt. & Pwr., 5% pf.	100	91	100
N. Y. Central Elec., 7% pf.	105	101	105½
New York Power & Light 7% pf.	115½	....	....
NiagaraFalls Pwr., 7% pf.—25	k 27½	27½	28½
No. Amer., 6% pf.—50	55	53½	55
No. Amer., com.—10	67½	58½	68½
No. Amer. Edison, $6 pf.—no par	104	102½	105½
Northeastern Pwr., com.	27½	19½	30
No. N. Y. Utilities, 7% pf.	109	103	109
No. Ohio Pwr., com.—no par	26½	18	28
Northern Ohio Pwr. & Lt., 6% pf.	99	90	99
No. Ont. Lt. & Pr. 6% pf.	k100	94	100
No. Ont. Lt. & Pwr., 4% com.	k 72	73	78
No. States Pwr. (Del.), 7% pf.	109	101	110
No. States Pwr. (Del.), 8% com.	146½	123	149
No. Texas Elec., 6% pf.	54½	45	70
No. Texas Elec., com.	17	....	....
OHIO BRASS, com. B $4—no par.	k 96	90	107
Ohio Brass, 6% pf.	k105	106	111
Ohio Pwr., 6% pf.	108½	104	109½
Ohio Pub. Serv., $6 pf.	105	95	105
Ohio Pub. Serv., 7% pf.	113	107	112
Ohio River Edison, 7% pf.	109	106	109½
Oklahoma Gas & Elec., 7% pf.	114½	106	115½
PACIFIC Gas & ELEC., 6% pf.	29½	26½	29½
Pacific Gas & Elec., 8% new com.	48	43½	49½
Pacific Pwr. & Lt., 7% pf.	l110	106	110
Penn Cent. Lt. & Pwr., $5 pf.—no par	c 81½	79½	82
Penn-Ohio Edison, 6% pf. no par	98½	93½	99
Penn-Ohio Edison, 7% pf.	108	97½	109
Penn-Ohio Pwr. & Lt., 7% pf.	110	....	....
Penn Pwr. & Lt.—$7—no par	l110	109½	110½
Penn Wtr. & Pwr., $2.50 com., new	e 78	68	78
Phila. Co., 5% pf.-50	46	45½	48½
Phila. Co., 6% pf.—50	k 56½	52	57
Phila. Co., com.—50	k165½	145	166
Phila. Elec., 8% com.—25	m66½	55½	66½
Portland Elec. Pwr., 7% pf.	103	100	104½
Portland Elec. Pwr., 6% pf.	95	78	96
Portland Elec. Pwr., 6% 2d pf.	85	55	88
Portland Elec. Pwr., com.	45	42½	52
Potomac Elec. Power, 6% pf.	l112½	....	....
Pwr. Sec., pf.—no par	65	50	68
Pwr. Sec., com.—no par	12	11	13½
Public Serv. of Colorado, 7% pf.	105	....	....
Pub. Serv. of N. J., 6% pf.	111	103½	111
Pub. Serv. of N. J., 7% pf.	125	118	125½
Pub. Serv. of N. J., $2 com.—no par	54½	41½	56
Pub. Serv. of No. Ill., 6% pf.	a111	....	....
P. S. of No. Ill., com. $8—no par	a173	159½	180
Pub. Serv. of No. Ill., $8 com.	a174	159½	180
Pub. Serv. of Okla., 7% pr. ln.	106½	100	107
Pub. Serv. Elec. & Gas, 6% pf.	k110½	108	110½
Puget Sound Pwr. & Lt., 7% pf.	k109½	105	109
Puget Sound Pwr. & Lt., $6 pf.—no par	105	92	105½
Puget Sound Pwr. & Lt., com.	k 81½	34½	84½
RADIO CORP. OF AMER., $3.50 pf.—50	56½	54½	57½
Radio Corp. of Amer., com.—no par.	179	85½	196½
Rochester Gas & Elec. 6% pf. D.	105½	105½	106½
Rochester Gas & Elec., 7% pf. B.	107	105	107
Rochester Gas & Elec., 6% pf. C.	105½	105½	106½
SAN JOAQUIN Lt. & Pwr., 7% pr. pf.	110	110	117½
St. Joseph Ry., L., H. & P., 5% pf.	k 75	70	75
Servel, Inc.	10	4½	10½
Sierra Pacific Elec., 2% com.	35½	29	38½
Sioux City Gas & Elec., 7% pf.	107½	100	108½
Southeastern Pwr. & Lt., pf.—$7 no par	j 109	....	....
Southeastern Pwr. & Lt., pfc. pf.	j 89½	....	....
Southeastern Pwr. & Lt., com.—no par	51½	40½	53½
So. Calif. Edison, 8% pf.	k 47	38½	41
So. Calif. Edison, 7% pf.	29	27½	29½
So. Calif. Edison, 6% pf.	27½	25½	27½
So. Calif. Edison, 8% com.	46	43½	48½
Southern Cities Utilities, 7% pf.	83	75	87
Southwestern Lt. & Pwr., A $3.	80	60	80
Southwestern Lt. & Pwr., B.	65	60	65
Southwestern Lt. & Pwr., $6 pf.	95	88	96½
Southwestern Pwr. & Lt., 7% pf.	k113½	103	115
Standard Gas & Elec., 8% pf.	70	65	71
Standard Gas & Elec., 7% pr. pf.	114	108	115
Standard G. & E., com. $3.50	67	57½	70
Standard Power & Light, com.	43½	29½	45
Standard Pwr. & Lt., 7% pf.	k105½	98	106
Staten Island Edison, pf.—$6—no par	102½	99	103½
Superheater, $6 com.—no par	160	....	....
Syracuse Lighting, 7% pf.	110	103	111
Syracuse Lighting, 8% pf.	k117½	114	119
TAMPA ELEC., com. $2.	m 68½	62	69½
Tenn. Elec. Pwr., 6% pf.	103½	92	103
Tenn. Elec. Pwr., 7% pf.	109	107	110
Terre Haute, Ind. & East. Trac., 5% pf.	k 10	....	....
Terre Haute, Ind. & East. Trac., com.	k 1	....	3
Tex. Pwr. & Lt., 7% pf.	l113	113½	115
Tide Water Pwr., 8% pf.	112	108	112
Timken Roller Bear., com.—$4 no par	127	112½	134
Toledo Edison, 7% pf.	109½	108	111
Toledo Edison, 6% pf.	105	95	105
Toledo Edison, 6% com.	k145	120	150
Tri-City Ry. & Lt., 6% pf.	k 88	88	102
UNITED GAS & ELEC., 7% pf.	96	98	103
United Gas & Elec. (N. J.), 5% pf.	75	70	77
United Gas Impr., 8% com.—50	a130½	111½	135½
United Lt. & Pwr., pf.—$4—no par	k 55	49	56½
United Lt. & Pwr., pf.—$6.50—no par	a102½	95	102½
United L. & P., com. A .48—no par	a 24	14	25½
United L. & P., com. B .48—no par	k 29½	20	29½
Utah Pwr. & Lt., 7% pf.	l112½	109½	112
Utica Gas & Elec., 7% pf.	105½	105	106½
Utica Gas & Elec., 8% com.	k200	215	225
Utilities Pwr. & Lt., 7% pf.	101	98	103
Utilities Pwr. & Lt., com. A $2.	32½	28½	34½
Utilities Pwr. & Lt., com. B $1—no par	28	18½	30½
VERMONT HYDRO-ELEC., 7% pf.	100	95	102
Virginia Elec. & Pwr., 7% pf.	k110½	109	111
Virginia Public Service 7% pf.	102½	97	103½
WAGNER ELEC., 7% pf.	b102	96½	102
Wagner Elec., com.—no par	b 71	37	60
Washington Ry. & Elec., 5% com	j485	....	....
Washington Ry. & Elec., 7% pf.	j102½	....	....
Washington Wtr. Pwr., 8% com.	227	175	235
West Penn Elec., 7% pf.	114½	109½	115
West Penn Elec., Cl. A $7.	110½	106½	115
West Penn Pwr., 7% pf.	115½	114½	117
West Penn Pwr., 6% pf.	109	108½	113
West Virginia Lt., Ht. & Pwr., 7% pf.	95	94	100
Western Pwr., 7% pf.	104	98	105
Western States Gas & Elec., 7% pf.	k102	100	106
Western States Gas & Elec., com.	m 38	....	....
Westinghouse Elec. & Mfg., 8% com.—50	101	88½	112
Weston Elec. Instrument, Cl. A $2—no par	g 33	30½	34
Weston Elec. Instrument, com.—no par	18½	12½	18½
Wheeling Elec., 6% pf.	106	95	109
Worthington Pump, 7% pf. A	k 57	45½	57
Worthington Pump, 6% B	45	41	49½
Worthington Pump, com.	31½	28	34½
YALE & TOWNE com. $5—25.	80	68½	80

Stock Exchange: aChicago; bSt. Louis; cPhiladelphia; dBoston; eBaltimore; fMontreal; gCincinnati; hSan Francisco; iPittsburgh; jWashington. kBid price Saturday, April 21. lBid price Wednesday, April 25. mLatest quotations available. †Dividend rate variable.

accrued interest on June 1, 1928, all its first mortgage sinking fund gold bonds, 6½ per cent series, due 1950, issued and outstanding.

RECENT LISTINGS.—The New York Stock Exchange has authorized the listing of 5 per cent cumulative first preferred stock of the Duquesne Light Company to the amount of $20,000,000 and additional shares of common stock of the Engineers Public Service Company—no par value— numbering 100,000. There has also been authorized the listing of not exceeding $64,530 common stock of the Federal Light & Traction Company on official notice of issuance as a stock dividend, making the total amount applied for $6,517,965 common stock. The listing has also been authorized of 115,403 additional shares of common stock without par value of the North American Company, on official notice of issuance as a stock dividend, making the total number of shares applied for to date 4,742,861 shares. The New York Stock Exchange has authorized the listing of 14,000 additional shares of class A stock of the Utilities Power and Light Corporation without par value, on official notice of issuance and payment in full, making the total amount applied for 584,000 shares of class A stock.

ILLINOIS STOCKHOLDERS AUTHORIZE NEW PREFERRED ISSUE.—At a special meeting held April 23 stockholders of the Illinois Power & Light Corporation approved the new set-up outlined in the March 24 issue of the ELECTRICAL WORLD. The plan calls for the issuance of 600,000 shares of no-par value preferred stock, proceeds from the sale of which will be used to refund the 7 per cent cumulative preferred stock now outstanding. The new stock will be callable at 110.

CALIFORNIA UTILITY INCREASES CAPITAL STOCK.—The San Diego Consolidated Gas & Electric Company, San Diego, Cal., has recently increased its capital stock from $20,000,000 to $30,000,000.

NEW YORK STATE ELECTRIC INCREASES SHARES.—The New York State Electric Corporation has filed a certificate in the office of the Secretary of State increasing the number of shares from 100,000 (no par value) to 150,000 shares (no par value).

Cities Service Adds 50,000 New Stockholders

More than 50,000 new names have been added to the security holders' list of the Cities Service Company during the past year, according to a recent announcement made by the company. The list now totals 350,000.

Electric Bond & Share to Issue Stock

The board of directors of the Electric Bond & Share Securities Corporation has voted to offer pro rata to the common stockholders of that corporation of record April 30 the privilege of subscribing at $80 per share for one share of its common stock for each three shares of common stock held by them, respectively. This will call for the issuance of 600,957 shares of its authorized common stock.

Twenty per Cent in Utilities

The Metropolitan Life Insurance Company, one of the nation's largest investors, has 20 per cent of its entire bond holdings in public utility bonds. Out of a total of $990,996,000 invested in bonds, both domestic and foreign, $200,004,300 are the bonds of public utilities and almost $60,000,000 of this was added during 1927.

MOHAWK-HUDSON CORPORATION INCREASES PREFERRED STOCK.—At the annual meeting of the stockholders of the Mohawk-Hudson Power Corporation it was voted to increase the authorized shares of preferred stock to 500,000 from 400,000 and the authorized shares of second preferred stock from 250,000 to 500,000. One new director was elected, Frederick J. Fuller, vice-president of the Central Union Trust Company, to succeed the lates James C. Brady. Other directors were re-elected.

ANNUAL REPORT OF G. E. EMPLOYEES' SECURITIES CORPORATION. — The fifth annual report of the G. E. Employees' Securities Corporation shows a total of 27,147 bondholders, an increase of 1,660 over a year ago, with an average holding of approximately $1,000. In addition there are 5,000 employees of the General Electric Company who are paying for bonds on installment subscriptions. The total amount paid bondholders as interest during 1927 amounted to $1,647,500. This brings the total of all payments to bondholders, including the extra 2 per cent paid by the General Electric Company since organization of the corporation, to $6,227,975. Total assets of the corporation amount to approximately $45,000,000, more than $9,000,000 in excess of 1926. Net income from operations amounted to $1,046,845, an increase of $315,465 compared with 1926.

Company Reports

Name of Company	Gross Earnings Twelve Months Ended March 31 1928	1927
Bangor Hydro Electric	$1,884,474	$1,774,715
Central Illinois Light	4,491,111	4,261,654
Cities Service	32,941,878	28,106,804
Commonwealth Power	54,507,811	50,205,325
Consumers Power	27,578,019	24,732,676
Detroit Edison	*13,895,895	*12,775,321
Illinois Northern Util	3,360,049	3,140,684
Illinois Power	2,662,594	2,594,906
Kansas City Pwr. & Lt	13,014,063	11,086,228
New York Power & Light	19,286,360	18,019,479
Ohio Edison	1,967,630	1,844,638
Portland Electric Power	12,224,228	11,943,438
So. Indiana Gas & Elec	3,066,103	2,937,885
Tennessee Electric Power	12,760,388	11,998,918

More than 80,000,000,000 Kw.-Hr. Generated in 1927

AN OUTPUT of 80,205,474,000 kw.-hr. was produced by public utility power plants in the United States in 1927, according to a recent compilation of the United States Geological Survey. Of this total the output from water power amounted to 29,875,008,000 kw.-hr., or 37.2 per cent, the balance, 50,330,466,000 kw.-hr., being produced from fuel. The fuel consumption consisted of 41,888,000 tons of coal, 6,782,000 bbl. of fuel oil and 62,919,000,000 cu.ft. of natural gas. This is equivalent to 45,910,000 net tons of coal, from which there was generated 49,995,000,000 kw.-hr. at an average fuel consumption of 1.84 lb. of coal per kilowatt-hour; for the small remainder wood fuel was used, more than two-thirds of it in Oregon.

In 1919 the average consumption of coal was 3.2 lb. per kilowatt-hour, in 1926 it was 1.95. The improvement in efficiency has been steady throughout this entire period.

The leading division in the use of water power is the Pacific, where it constituted 90.1 per cent of the total; the next is the Mountain, with 86.2 per cent. The imports from Canada during the year came to 1,632,609,000 kw.-hr. and the corresponding exports to Canada were 4,868,000 kw.-hr.

The generator capacity, 25,398,385 kw. in 3,805 plants in 1927, increased to 27,690,891 kw. in 3,740 plants in January, 1928. Only plants of 100 kw. or larger are here included and only establishments generating energy are counted. The data should therefore not be confused with other compilations which also comprise smaller companies, or those engaged exclusively in resale of purchased energy.

These figures apply to all public utility power plants, including electric light and power, railways, Bureau of Reclamation and certain manufacturing plants selling energy for public utility purposes. Regional data are given in the accompanying tables. The compilation as published by the survey includes detailed data for the individual states.

Table I—Public Utility Power Companies in the United States and Capacity of Generators, Jan. 1, 1927-1928*

Division and State	1927 Operating Companies	1927 Plants	1927 Capacity of Generators (Kilowatts)	1928 Operating Companies	1928 Plants	1928 Capacity of Generators (Kilowatts)
United States	2,058	3,805	25,398,385	1,820	3,740	27,690,891
New England	185	338	2,358,939	168	330	2,466,705
Middle Atlantic	256	468	6,646,142	214	436	7,113,361
East North Central	414	786	5,925,149	361	735	6,311,870
West North Central	422	706	1,886,186	387	682	2,008,224
South Atlantic	253	412	2,835,074	223	429	3,475,795
East South Central	110	196	1,221,372	104	200	1,330,756
West South Central	176	339	910,056	142	385	1,079,940
Mountain	151	277	877,911	139	274	975,419
Pacific	91	281	2,737,556	82	269	2,928,821

*Includes only plants of 100 kw. or larger.

Table II—Production of Electric Power by Public Utility Power Plants in the United States in 1927

Compiled by Division of Power Resources, United States Geological Survey

Division and State	Total Power Kilowatt-Hours	Total Power Per Cent of U. S. Total	Water Power Kilowatt-Hours	Water Power Per Cent of Total Power	Water Power Per Cent of U. S. Water Power	Fuel Power Kilowatt-Hours	Fuel Power Per Cent of Total Power	Fuel Power Per Cent of U. S. Fuel Power
United States	80,205,474,000	100.00	29,875,008,000	37.2	100.00	50,330,466,000	62.8	100.00
New England	5,470,556,000	6.82	1,989,386,000	36.4	6.66	3,481,170,000	63.6	6.92
Middle Atlantic	21,716,770,000	27.08	6,216,326,000	28.6	20.81	15,500,444,000	71.4	30.80
East North Central	18,843,349,000	23.49	2,409,740,000	12.8	8.07	16,433,609,000	87.2	32.65
West North Central	4,841,453,000	6.04	1,650,173,000	34.1	5.52	3,191,280,000	65.9	6.34
South Atlantic	8,768,076,000	10.93	2,998,728,000	34.2	10.04	5,769,348,000	65.8	11.46
East South Central	3,407,700,000	4.25	2,211,600,000	64.9	7.40	1,196,100,000	35.1	2.38
West South Central	3,315,382,000	4.13	66,737,000	2.0	0.22	3,248,645,000	98.0	6.46
Mountain	3,520,047,000	4.39	3,033,688,000	86.2	10.16	486,359,000	13.8	0.97
Pacific	10,322,141,000	12.87	9,298,630,000	90.1	31.12	1,023,511,000	9.9	2.03

Business News and Market Conditions

Committee Appointed to Study Sub-Standard Material

At a meeting held at the auditorium of the Consolidated Gas Company's building, New York City, on March 29 Charles L. Eidlitz, chairman of the board of governors of the Electrical Board of Trade of New York, Inc., was instructed to appoint a committee to try to crystallize the thoughts and intentions of the industry along lines which may result in controlling the manufacture, sale and use of sub-standard and hazardous materials and appliances. A report of this meeting appeared in the April 7, 1928, issue of the ELECTRICAL WORLD on page 737.

The following committee has been appointed by Mr. Eidlitz: J. C. Forsyth, chairman, New York Board of Fire Underwriters; Nicholas J. Kelly, New York City department of water supply, gas and electricity; H. R. Sargent, General Electric Company; Louis Freund, contractor; Edward C. Brown, contractor; Harry Kirkland, Society for Electrical Development; L. E. Moffatt, *Electrical Merchandising;* Frank Pattison, consulting engineer, and T. H. Joseph, contractor.

Electrical Committee to Hold Special Meeting

A special meeting of the electrical committee of the National Fire Protection Association will be held at Atlantic City on May 3, 4 and 5, 1928, in the Chalfonte Hotel. A meeting of the correlating committee also has been called for the early morning of May 3. The annual meeting of the N.F.P.A. will begin on Monday, May 7.

The first meeting of the correlating committee was held on March 22, 23 and 24 last in accordance with the ac-

Value and Destination of Electrical Exports for January, 1928, Compared With Corresponding Month in 1927

(Issued by Bureau of Foreign and Domestic Commerce)

Articles	January 1927	January 1928
Direct current:		
Under 500 kw.	$106,999	$110,965
500 kw. and over	54,700	29,059
Alternating current:		
Under 2,000 kva.	13,135	18,606
2,000 kva. and over	77,018	119,588
Steam turbo-generator sets	52,411	51,945
Accessories and parts for generators	100,243	79,606
Self-contained lighting outfits	64,280	83,051
Batteries:		
Flashlight batteries	157,815	240,821
Other dry and wet cell primary batteries	156,162	180,616
Storage batteries	346,520	246 502
Transforming or converting apparatus:		
Power transformers	132,905	.....†
Power transformers, 500 kva. and over	.....*	43,752
Distribution transformers, less than 500 kva	.....*	46,454
Other transformers	78,983	.....†
Instrument transformers	.....*	8,582
Other transformers, not elsewhere specified	.....*	74,253
Battery chargers under 15 amp.	.....*	9,205
Rectifiers, double current and motor-generators, dynamotors, synchronous and other converters	130,679	100,020
Transmission and distribution apparatus:		
Switchboard panels, except telephone	84,643	106,242
Switches and circuit breakers over 10 amp.	173,653	134,646
Fuses and fuse blocks	34,188	31,841
Watt-hour and other measuring meters	42,574	57,948
Volt, watt and ampere meters and other recording, indicating and testing apparatus	161,234	.....†
Electrical indicating instruments	.....*	27,525
Electrical recording instruments	.....*	17,232
Other electrical testing apparatus	.....*	102,158
Lightning arresters, choke coils, reactors, and other protective devices	68,111	57,021
Motors, starters, and controllers:		
Motors under 1 hp.	169,458	.....†
Motors ¼ hp. and under	.....*	110,476
Motors over ¼ hp. and under 1 hp.	.....*	76,934
Stationary motors:		
1 to 200 hp.	207,288	184,335
Over 200 hp.	14,629	84,333
Railway motors	105,192	51,459
Electric locomotives:		
Railway	.....	74,780
Mining and industrial	17,344	298,621
Station and warehouse electric motor trucks	21,141	11,884
Starting and controlling equipment:		
For industrial motors	87,158	149,479
For electric railway and vehicle motors	32,708	12,312
Portable electric tools	80,173	84,537
Accessories and parts for motors	164,457	177,950
Electric appliances:		
Electric fans	87,580	24,908
Electric lamps:		
Metal filament	183,296	95,596
Other electric lamps	32,641	33,257
Flashlights	162,068	195,988
Searchlights and projectors	130,841	40,061
Motor-driven household devices	165,518	.....†
Electric vacuum cleaners	.....*	70,339
Other motor-driven devices, except tools	.....*	71,053
Electric flatirons	.....*	16,366
Domestic heating and cooking devices	107,548	.....†
Electric cooking ranges	.....*	41,701
Other domestic heating and cooking devices	.....*	59,771
Industrial electric furnaces and ovens	18,782	38,925
Therapeutic apparatus, X-ray machines, galvanic and faradic batteries, etc.	156,598	124,419
Signal and communication devices:		
Radio apparatus:		
Transmitting sets and parts	11,311	126,154
Receiving sets	202,095	209,323
Tubes	55,102	87,396
Receiving-set components	177,465	240,897
Receiving-set accessories	165,687	109,125
Telegraph apparatus	149,106	41,324
Telephone apparatus:		
Telephone instruments	36,263	11,207
Telephone switchboards	4,451	13,919
Other telephone equipment	231,940	246,252
Railway signals, switches, and attachments	33,871	46,967
Bells, buzzers, annunciators, and alarms	20,233	20,315
Other electric apparatus:		
Spark plugs, magnetos, and other ignition apparatus	211,115	.....†
Spark plugs	.....*	28,837
Other starting, lighting, and ignition equipment	.....*	135,247
Insulating material	129,049	103,502
Metal conduit, outlet, and switch boxes	54,390	69,938
Sockets, receptacles, and lighting switches	164,927	119,234
Electric lighting fixtures, interior and street	159,956	.....†
Electric interior lighting fixtures	.....*	143,311
Electric street lighting fixtures	.....*	57,607
Other wiring supplies and line materials	104,825	73,980
Other electrical apparatus, not elsewhere specified	729,211	579,515
Rubber and friction tape	32,372	28,239
Globes and shades for lighting fixtures	52,005	41,205
Electrical glassware except for lighting	24,212	29,051
Electrical porcelain:		
For less than 6,600 volts	54,958	44,382
For 6,600 volts and over	50,472	51,227
Carbons, carbon brushes and electrodes:		
Electrodes for electric furnaces	176,484	173,811
Other carbon products	179,221	44,188
Insulated wire and cable (iron or steel)	19,420	25,069
Copper, bare wire	143,645	191,293
Copper, insulated wire and cable	365,301	323,174
Refrigeration sets up to 1 ton capacity	172,917	294,844
Domestic washing machines	80,784	82,427
Totals	$7,973,461	$7,981,082

*Not collected in 1927. †Data for 1928 collected in more detail as given.

DESTINATION OF ELECTRICAL EXPORTS

Country of Destination	January, 1928
EUROPE:	$1,642,922
Belgium	59,021
France	113,473
Germany	129,000
Italy	174,604
Netherlands	72,707
Spain	234,301
Sweden	61,643
United Kingdom	492,188
Other countries	305,985
WESTERN HEMISPHERE:	$4,366,498
Canada	1,571,730
Mexico	287,329
Cuba	250,714
Argentina	636,357
Brazil	691,688
Chile	184,026
Colombia	161,995
Peru	46,577
Venezuela	102,580
Other countries	433,502
ASIA, AFRICA, AND OCEANIA:	$1,971,662
British India	290,529
China	104,588
Japan	305,157
Philippine Islands	174,647
Australia	514,872
New Zealand	84,921
Union of South Africa	187,311
Other countries	309,637

tion taken at the February, 1928, meeting of the electrical committee. The program followed by the correlating committee and which was suggested by Chairman V. H. Tousley was as follows:

1. That an editorial committee of three be appointed to prepare, and report to the meeting, wordings for requirements agreed upon in principle.
2. That any single item not agreed upon within ten minutes of discussion should be laid upon the table for discussion at the end of the meeting.
3. That only those items adopted by a two-thirds majority should be included in the correlating committee's report to the electrical committee with the recommendation that they be adopted at the special May meeting.
4. That items not so agreed upon should be referred to the electrical committee with the recommendation that they be treated as a special order of business at the February, 1929, meeting of the electrical committee.

Productive Activity for Quarter 1 per Cent Over 1927

Electrical Manufacturing Industry Following 1927 Trend, But on Slightly Higher Plane—March Rate of Operations 2.3 per Cent Over 1927

THAT the electrical manufacturing plants of the nation are operating at a slightly higher rate than the same time last year is indicated from reports on March consumption of electrical energy received by the ELECTRICAL WORLD from a large proportion of these plants. The average rate of productive operations during the first quarter of 1928 was about 1 per cent over that for the same period in 1927, but the March activity was 2.3 per cent over March last year. It would appear, therefore, that the operations of the electrical manufacturing plants during the present year are following very closely the trend witnessed during 1927, but on a slightly higher plane. The March rate of activity was 5.4 per cent below February and 12.3 per cent under October, the peak month for the past season. This reduction in activity, however, is perfectly normal in this industry. Past history would indicate that an upward turn will probably take place in April, although last year April activity was 3.4 per cent under March.

The index of activity in the electrical manufacturing industry based on consumption of electrical energy stands at 115.3 for March, as compared with 121.8 in February and 124.7 in January. Comparative indexes of productive activity referred to the average activity for the period 1923-25 as 100 and adjusted for number of working days are as follows:

March, 1928	115.3
February, 1928	121.8
October, 1927 (peak month)	131.3
March, 1927	112.7
Average first quarter 1928	120.6
Average first quarter 1927	119.3

The operations of the larger electrical manufacturing companies showed a much larger drop in activities from February to March than was reported by the smaller companies. Both groups, however, are now operating at about the same rate as compared with the average rate of activity during 1923-25.

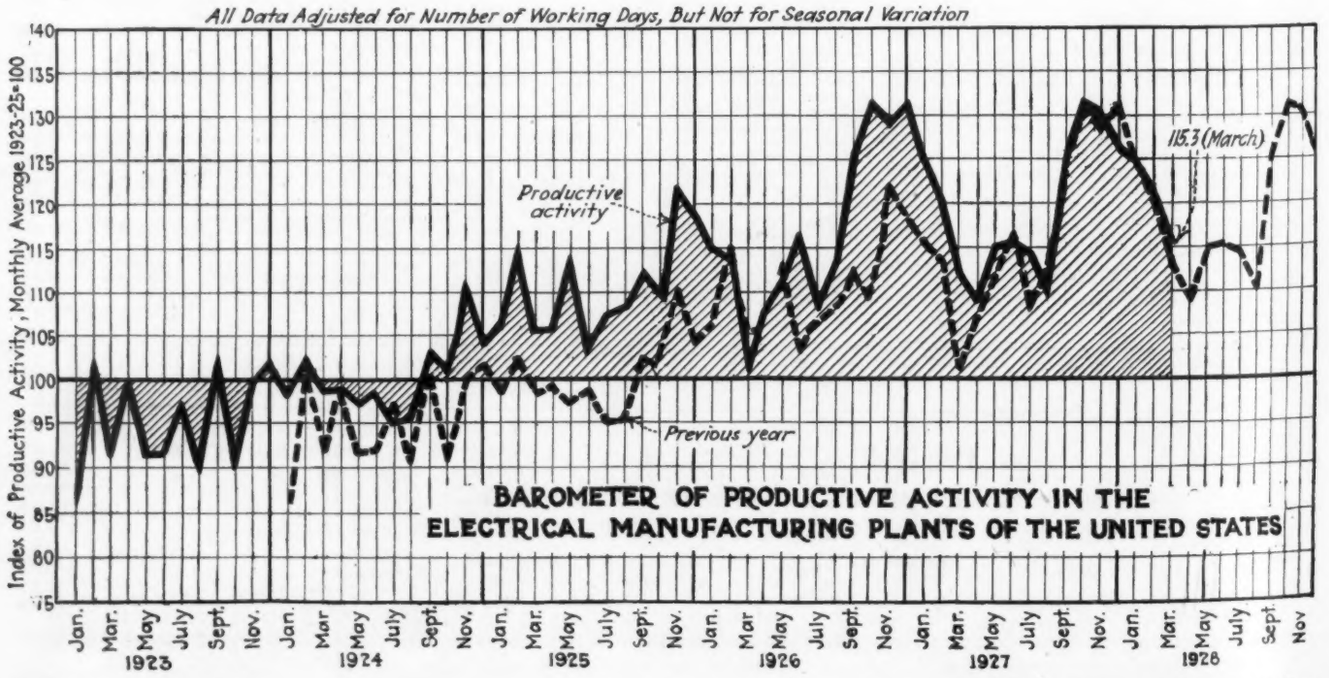
Market Conditions

CENTRAL-STATION buying continues to be quiet with conditions better than they were earlier in the year. Industrial plants are purchasing in fair volume although the activity is not as great as it was last year. It is anticipated that the Lackawanna Railroad will place orders within the next 60 days for electrical equipment in connection with the electrification of its suburban system in northern New Jersey at a cost of about $14,000,000.

In New England industrial plant buying was outstanding. Two orders for motors and control totaled over $150,000. Power companies are active in the Eastern district, and industrial business continues at a fair rate. In the Southeast power companies are buying conservatively though a few large orders are reported. Business is quiet in St. Louis but inquiries are good. In the Middle West conditions are gradually improving. On the Pacific Coast orders have been disappointing but prospective business is excellent. An order for $250,000 worth of equipment was placed by the Washington Pulp & Paper Company.

Copper and Zinc Markets Stiffen

A moderate volume of business with a firmer tendency in prices for copper and zinc is the feature of the week in the non-ferrous metal markets. More sales of copper are reported than for three weeks and since Monday there has been decidedly less tendency to shade the price of 14¼ cents asked by the primary producers. The sellers of zinc have not pressed metal on the market and were



NEW YORK METAL MARKET PRICES

	Apr. 18, 1928 Cents per Pound	Apr. 25, 1928 Cents per Pound
Copper, electrolytic	13.9875	14.00
Lead, Am. S. & R. price	6.10	6.10
Antimony	10.00	10.00
Nickel, ingot	35.00	35.00
Zinc spots	6.10	6.15
Tin, Straits	52.50	52⅛
Aluminum, 99 per cent.	24.30	24.30

Base copper wire price April 25, 1928, 16 cents.

able to realize slightly higher prices for the modest tonnage traded in. Lead is steady at 6.10 cents, New York, and 6 cents, St. Louis, and tin after a slight sag is back in the neighborhood of 52⅛ cents for prompt Straits.

Industrial Buying Heavy in New England

Sales of general purpose motors, control equipment and switchboards were outstanding items of interest in the electrical market in the New England district. Small motor sales mounted to over $50,000, which is slightly above the normal, with a higher trend. One order amounting to about $12,000 worth of motors was reported. Another order for complete installation of operating and control equipment for a well-known Connecticut industry totaled about $140,000.

Central-station buying is spotty. An encouraging demand for insulators and line material was recorded. Interest in arc welding is strong with orders gaining over last year. Street-lighting business is active, and one manufacturer records much activity in automatic street traffic signals, sales of which mounted to over $10,000 for the first quarter of this year. Industrially the New England district is gaining, with exceptions in a few instances.

Power Companies Buying in Good Volume in Southeast

Central-station companies in the Southeast are buying conservatively, though a few large orders are reported. A company operating in the Carolinas has placed an order for 2,800 electric ranges to use in a sales campaign, and a company in Mississippi ordered motors totaling about $20,000. A company in south Georgia ordered oil engine generating equipment, amounting to $40,000, for use as a stand-by for a small hydro-electric plant. The demand for creosoted pine poles is very active and as a result deliveries are unsatisfactory. An order for $30,000 worth of oil circuit breaker equipment is in immediate prospect.

A cotton mill in Georgia bought $2,500 worth of wiring materials and $10,000 worth of motors were recently ordered. An additional order for wiring materials amounting to about $5,000 is in immediate prospect. A cotton mill in the Carolinas ordered motors amounting to $2,800 and several synchronous motor orders are being received for new ice plants in the territory, the latter orders averaging $1,000 each. Construction contracts have been let on the new building program of the Southern Railway in Atlanta and some orders for electrical materials, of which about $25,000 worth will be needed, have already been placed.

Two municipalities in Louisiana ordered "white-way" equipment amounting to $12,000 and $9,000, respectively. A club in Birmingham has placed an order for $3,000 worth of electrical cooking equipment for a completely electrified kitchen. Construction projects are as follows:

The Georgia-Florida Power Company, Valdosta, will construct 13 miles of transmission line and install two substations at Pavo and Barwick where municipal plants have been acquired. Swift & Company, Chicago, plans a cottonseed oil mill at Jacksonville, Fla., to cost $225,000. The Roberts & Grentner Properties, Inc., Miami, Fla., plans a cold storage plant to cost $300,000. The Powell Knitting Company, Spartanburg, S. C., plans an addition to cost $180,000. The South Carolina Power Company, Charleston, S. C., has acquired the municipal plant at Walterboro, S. C., and plans an addition to cost $75,000. The Diamond Ice Company, Knoxville, Tenn., will build an ice plant to cost $150,000. Lake Placid, Fla., and Danville, Va., plan ornamental lighting systems. The Virginia Electric & Power Company, Richmond, Va., plans to expend $4,000,000 for improvements throughout its territory. Of this amount $1,300,000 will be used for street railway and gas works.

Conditions Gradually Improving in Middle West

While the volume of business transacted in the Middle West is not large, conditions are improving. Considerable interest is being aroused in the coming World's Fair in Chicago in 1933. The railroads are coming into the market for a considerable quantity of equipment and general purchasing of maintenance materials is heavy. The various utility companies are actively engaged in spring construction work and maintenance purchasing is particularly heavy. Among the interesting orders placed were one for labor and material to build foundations for coal handling structure, complete with appurtenances valued at $130,000; cable valued at $28,000; five 1,000 kva. transformers; six 10-ton hand operated hoists complete with appurtenances and "Mazda" lamps valued at $150,000. Jobbers sales are improving. Construction projects are as follows:

The J. W. Hoodwin Company, Chicago, will build a factory for making advertising novelties, at a cost of $100,000. The Halsom Products Company, Chicago, will build a toy manufacturing plant to cost $100,000. Kendallville, Ind., plans additions to its municipal plant, to cost $50,000. The Detroit Electric Company, Detroit, plans an operating unit on West Jefferson Street to cost $120,000. The Chevrolet Motor Car Company, Detroit, will build an addition to cost $400,000. Durant Motors, Inc., Lansing, Mich., will build additions to its plant to cost $700,000. The Northern States Power Company, Minneapolis, Minn., will make additions in its power plant at Minot, N. D., to cost $75,000. The Madison Gas & Electric Company, Madison, Wis., plans additions in its power plant at Madison, Wis., to cost $250,000. The Marshall Electric Company, Marshalltown, Iowa, will build extensions to transmission lines. The Nebraska Power Company, Omaha, Neb., will make extensions in transmission lines in the vicinity of Waterloo, Neb. Westmont, Ill., and Appleton and Neenah, Wis., plan ornamental street-lighting systems.

Industrial Demand Active in Eastern District

Industrial business continues at an encouraging status in the Eastern district and sizable contracts have been placed for motors, control apparatus and accessory equipment. A leading manufacturer has secured an order from a steel tube mill in Ohio for $22,500 worth of motors. A cement company in eastern Pennsylvania also ordered nine generator units, motors and auxiliary equipment for a conveyor drive. A contract was placed by a rolling mill at Trenton, N. J., for heavy industrial equipment aggregating $168,000. Hotel interests in the metropolitan district are reported in the market for construction material. There is a marked increase in the demand for fractional-horsepower motors. The shoe manufacturing industry has been active. There is a marked decline in the call by jobbers for electric fans.

Power companies are active in the market for requirements for early delivery, particularly in connection with substation equipment. A metropolitan utility has placed an order for $25,000 worth of transformers. Other business of similar character is coming from central stations in northern New York, as well as in New Jersey. Line equipment, which has been showing a tendency to lag under a demand primarily of maintenance character, is operating under an improved call. A manufacturer of wire and cables reports business as unsatisfactory for April. May account, however, is expected to bring about a noticeable increase in orders as indicated by present inquiries. Current construction operations include the following:

The New York, New Haven & Hartford Railroad, New York, plans an electrical inspection shop on Mathews Avenue to cost $180,000. The Erie Railroad will make extensions at its shops at Port Jervis and Hornell, N. Y., and Meadville, Pa., to cost $250,000. The Wright Aeronautical Corporation, Paterson, N. J., will build plant additions to cost $2,500,000. The Public Service Electric & Gas Corporation, Newark, N. J., will build a transmission line from Metuchen to Liberty Corner, and thence through Somerset and Hunterdon Counties to Lambertville. The Otis Elevator Company will build a plant addition at Harrison, N. J., to cost $350,000. The Trenton Potteries Company, Trenton, N. J., will make plant extensions to cost $400,000. The Atlantic City Electric Company, Atlantic City, N. J., has acquired the municipal plant at Gibbstown, N. J.

England, Walton & Company, Philadelphia, will build an addition to its leather plant to cost $1,000,000. The Nice Ball Bearing Company, Philadelphia, plans an addition to cost $150,000. The Mine Safety Appliance Company, Pittsburgh, will take bids for an addition to cost $100,000. The Signal Corps, Baltimore, Md., is asking bids until May 16 for two 150-ft. steel radio towers (Circular 1). The Bureau of Yards

and Docks, Navy Department, Washington, D. C., is asking bids (no closing date stated) for generating equipment for naval station in Cuba (Specification 5356). The General Purchasing Officer, Panama Canal, Washington, D. C., is asking bids until May 14 for electrical appliances, wire, cable, etc. (Panama Schedule 1874.)

Business Quiet with Good Inquiries in St. Louis

Business in the St. Louis district is below the average of the previous week. Manufacturers report orders received are mainly for small motors and equipment but figures are being submitted on important inquiries to be closed in the near future. Retail dealers and jobbers experienced very satisfactory business from a steady volume of small orders for miscellaneous items, with appliances and building and line construction materials the most prominent. Construction projects are as follows:

The International Shoe Company, St. Louis, will build a canvas fabric mill at Malvern, Ark., to cost $150,000. The Beaumont Export & Import Company, Beaumont, Tex., plans a lumber mill to cost $100,000. The Chase Bag Company, Dallas, Tex., plans a plant on South Lamar Street, to cost $110,000. The Pure Oil Company, Houston, Tex., plans additions in its refinery, to cost $150,000. Nocona, Tex., plans a municipal power plant. The Central Power & Light Company, San Antonio, Tex., plans a hydro-electric plant on the Rio Frio River, to cost $250,000. Swift & Company, Chicago, plans a cold storage plant at South Dallas, Tex., to cost $150,000. The Texas-Louisiana Power Company, Fort Worth, Tex., plans a power plant near Yoakum, Tex., to cost $150,000. The United Power & Light Company, Abilene, Kan., has secured permission for a transmission line from Chandler to Luther, Okla. The Texas Power & Light Company, Dallas, Tex., has acquired the Corsicana (Tex.) Power & Light Company, and plans transmission line extensions. Bossier City, La., and Fort Stockton, Tex., plan ornamental lighting systems.

April Orders Off But Inquiries Good on Pacific Coast

April ordering on the Pacific Coast has been rather disappointing, although prospective business is excellent. Bumper crops are forecast by additions to packing plants at Concord, Santa Clara, Elmhurst and Watsonville. The state of California has announced a ten-year building program for the Sacramento State fair grounds comprising six major buildings of which the live-stock building will be completed for next year. Pole orders include one carload for Woodland, two carloads for Fresno and $7,500 worth of poles and pole line material for Fallon, Nev. The government has purchased 50 miles of No. 17 copper steel wire for the forest service and has placed a contract for $125,000 covering the wiring, heating, and plumbing of the submarine base in Pearl Harbor, Hawaiian Islands. Pumping plant business is running about 30 per cent over that of last year.

The Washington Pulp & Paper Company, a subsidiary of the Zellerbach Paper Company, has let contracts for furnishing approximately $250,000 worth of turbines, motors, etc., for plants building at Port Townsend and Hoquiam, Wash. An order amounting to $15,000 also was placed by the Union Bag & Paper Company at Tacoma for a switchboard. A 10,000-hp. turbine was purchased by the Grays Harbor Railway & Light Company at Aberdeen. The Weyerhaeuser Timber Company at Longview, Wash., issued specifications and will open bids in two weeks for approximately 10,000 hp. in motors, to cost about $150,000. Construction projects are as follows:

The Atchison, Topeka & Santa Fe Railway Company, Chicago, plans an ice and car re-icing plant at Ashfork, Ariz., to cost $650,000. Johns-Manville, Inc., New York, plans a new plant at Richmond, Calif., to cost $2,500,000. The San Diego Consolidated Gas & Electric Company, San Diego, Calif., plans a steam power plant on West Broadway, to cost $435,000. The Pacific Manufacturing Company, Santa Clara, Calif., plans a woodworking plant to cost $200,000. The Coast Counties Gas & Electric Company, Santa Cruz, Calif., will build a substation at Watsonville, Calif., to cost $30,000. The Public Service Company of Colorado, Denver, will build a storage plant to cost $350,000.

The Escalante Light & Power Company, Escalante, Utah, plans a power plant to cost $65,000. The Puget Sound Power & Light Company, Seattle, Wash., will build a substation on Massachusetts Street to cost $35,000. The Washington Water Power Company, Spokane, Wash., will build a substation on South Tacoma Street, to cost $50,000. The American Fruit Growers, Inc., Yakima, Wash., will build a cold storage plant to cost $140,000. The Great Western Power Company, San Francisco, Calif., has acquired the plant and property of the Quincy Electric Light & Power Company, Quincy, Calif. Tulare, Salinas, Monrovia, Orange, Auburn, Berkeley, and Sacramento, Calif., and Montesano, Wash., plan street-lighting systems.

Activities of the Trade

Industrial Heat School to Be Held at Mansfield, Ohio

Plans for the 1928 National Industrial Heating School, which will be conducted this year through the courtesy of the Westinghouse Electric & Manufacturing Company at Mansfield, Ohio, have just been announced by W. H. Sammis, chairman industrial heating committee, Commercial National Section, N.E.L.A. The dates for the school, which is open to representatives of public utilities, are May 14 to 26. The course will consist of lectures and studies conducted by nationally known authorities on the subject, supplemented by inspection trips through a number of large industrial plants for first-hand observation of industrial heating operation and results. Some 225 men have taken this course in the previous schools and their companies experienced profitable results.

The only cost to central-station companies sending men to take the course is the living (averaging perhaps $7 per day) and traveling expenses of their representatives for two weeks. Those desiring to take the course should send their enrollment to W. H. Sammis, chairman industrial heating committee, N.E.L.A., care of Consumers Power Company, Jackson, Mich.

THE SAFETY CABLE COMPANY, division of the General Cable Corporation, 420 Lexington Avenue, New York City, announces that Merritt L. Tice, formerly connected with the Benjamin Electrical Manufacturing Company, will represent the company in the Southeastern part of the country.

THE BLACK & DECKER MANUFACTURING COMPANY, Towson, Md., manufacturer of portable electric tools and grinders, announces that its Detroit branch is now located at 11501 Woodward Avenue, with J. H. Walker as manager. The company also announces the following changes in its sales organization: H. L. Balke is with the Kansas City branch, covering the territory around Omaha, formerly covered by S. D. Shawgo; G. F. Parr is with the Buffalo office, and has taken over the territory of J. H. Hutton; G. N. McCarthy has filled the vacancy at the Buffalo office made by H. B. Austin, who has been transferred to Chicago, and J. A. Murray is working in Baltimore, taking over the accounts formerly sold by Curtiss Watts.

THE EDISON ELECTRIC APPLIANCE COMPANY, 5600 West Taylor Street, Chicago, announces a new "Hotpoint" iron known as the "Super-Automatic" iron with the heat throttle.

THE DAMPNEY COMPANY OF AMERICA, Hyde Park, Boston, announces that the sale of its "Apexior" protective coatings for power plant equipment will be handled in Iowa, Kansas, western Missouri and eastern Nebraksa by F. W. Hay & Company, with main office at 2732 Cherry Street, Kansas City, Mo., and branches in Omaha and Cedar Rapids.

THE INGERSOLL-RAND COMPANY, 11 Broadway, New York City, announces the opening of a branch office at 226 West A Street, Picher, Okla., to serve northern Oklahoma, southern Missouri and Arkansas.

THE WESTINGHOUSE LAMP COMPANY has announced a reduction in the list price of its flashlight, radio panel, and toy train incandescent "Mazda" lamps, to become effective on May 1. The reduction, amounting to 23 per cent, was made possible, according to officials of the company, by the increased demand for these types of lamps, and particularly so by lower manufacturing costs, made possible by newly developed machines.

New Equipment Available

Magnetic Motor Starting Switch

The "Circle T" magnetic motor starting switch rated at from 1 hp. to 15 hp. has been placed on the market by the Trumbull Electric Manufacturing Company, Plainville, Conn. In this switch a set of moving contacts is used to bridge the gap between two sets of stationary contacts. High interrupting capacity is maintained because of this contact construction. Overload and undervoltage protection is obtained by thermal relays of the inclosed type. The contacts of this switch are self-aligning and self-cleaning.

Semi-Portable, Single-Stage Compressor Unit

A semi-portable, single-stage, double-acting, multiple-belt-driven air compressor which is completely self-contained and fully equipped has been placed on the market by the Pennsylvania Pump & Compressor Company, Easton, Pa. The motor, starter, multiple-belt drive, air receiver, air filter and automatic start and stop control are all assembled in place, forming a compact unit occupying the minimum of floor space. The air cylinder and all working parts are automatically lubricated. The compressor is equipped with Pennsylvania air-cushioned valves and contains all other features which are built into the company's standard compressors. The unit is equipped with a 10-hp. high-torque motor operating the compressor at 400 r.p.m. The unit has automatic pressure control between 85 lb. and 125 lb., is 6 ft. 8 in. long by 2 ft. 4 in. wide and weighs 1,380 lb. Another unit also is built in a two-stage type for pressures from 125 lb. to 250 lb.

SOLENOID BRAKES.—A complete new line of solenoid brakes is now being offered by the General Electric Company. The line, bearing the designation CR-9516, includes brakes for operation on alternating and direct current, and involves in its construction the use of a spring-setting device. The company claims simplicity as the main feature of the new line. The brakes are especially designed for severe service in connection with mill, crane and hoist motors. The manufacturer claims smooth operation for making quick stops in either direction of rotation, with a dependable holding value. The brake mechanism is held in the "off" position by a coil and plunger; when power is applied to the motor, the coil is energized and the brake is released, and, when the power is shut off, the spring-setting device forces the mechanism into the closed or braking position. Both alternating- and direct-current brakes use the same brake mechanism and frame, the solenoids being interchangeable. The solenoid assembly may be quickly removed from the brake mechanism by taking out four bolts, lever or brake adjustments remaining undisturbed. The coil only may be removed, if desired, from the larger sizes.

Portable Pole Saw

The Wolf portable timber-sawing machine for use in pole yards for the roofing of poles, the cutting of anchor blocks, the cutting up of old poles for fire wood and other operations has been placed on the market by the Reed-Prentice Corporation, Worcester, Mass. The company claims that the Wolf saw operated by two men will perform the work of at least eight men with hand cross-cut saws, and any operation ordinarily handled with cross-cut saws can be speeded up with the Wolf saw. The machine is available in alternating-current, direct-current and compressed-air drive and has a capacity up to timbers 24 in. in diameter.

Air Filter

A unit type air filter, for cleaning air used in cooling large motors, compressed air and similar purposes, using a blanket of cellulose material as the dirt-collecting medium, has been developed by the National Air Filter Company, Chicago. The new material, developed by the Kimberly-Clark company especially for the new filter, consists of a mat of many layers of very fine cellulose fibers. It will be known commercially as "Airmat." In a series of experimental tests the manufacturer states that he found the filter showed a surprisingly high efficiency in stripping the air passed through it, not only of the most minute particles of solid matter but of all particles of oil and oily soot. The material has a very high absorptive capacity for liquids.

A single unit consists of a sheet metal box 12 in. high, 24 in. wide and 24 in. long with a filtering capacity of 1,000 cu.ft. of air per minute. These units can be used singly or placed in multiple installations of any capacity, much after the fashion of sectional bookcases. The filtering material, resembling a very light fluffy white blanket, is carried between two frames of coarse wire screen hinged together on one side and opening out like a book. These frames are the proper size to receive a single sheet of the "Airmat," 24 in. square. Each unit contains four such frames, which form a set of staggered partitions being placed in cross-section like a letter W so that 16 sq.ft. of filter surface is contained in each individual unit. A simple spring clip holds the frames in position and they may be easily removed from the unit, opened up and a fresh blanket of "Airmat" inserted in a few seconds time without disturbing the unit itself.

Recorder Controller

A new recorder and contacting controller which combines in one case the features of a recorder and a thermometer controller is being marketed by the Bristol Company, Waterbury, Conn. The equipment is a single pen recording system with controller system and scale mounted directly above it. The recording pen and moving contact of the controller are each actuated by separate pressure elements which are exactly alike in construction. These elements are connected through one capillary tube to the sensitive bulb, and arranged in this way the record is not impaired by the retarding effect of the controller. Also the recorder draws a true record both above and below the control point.

The recorder controller is arranged for a contact capacity of 1,000 watts by equipping it with self-contained automatic switches. To use the instrument it is only necessary to set the control to the desired temperature by moving an index pointer over a scale to the exact degree to be controlled. This index pointer is very long and it is thus possible to adjust it accurately and easily. The large current-carrying capacity of this controller makes it possible to adapt the instrument to many control applications without the use of relays.

HIGHWAY LIGHTING UNIT.—A lighting unit designed especially for the illumination of highways has been placed on the market by the General Electric Company. The new unit is said to be of very simple construction and the light is diffused entirely by means of the combination glass globe and refractor which incloses the electric lamp. It may be mounted on standard poles, and does not require installation at excessive heights. Although particularly designed for highway lighting, it may be used in residential sections. The unit is designed for spacing at intervals of approximately 250 ft., and standard poles 25 ft. in height, or even less, may be used for mounting. The usual variety of types of casing and reflector will be available with these units, and several types and lengths of bracket can also be used.

CURRENT TRANSFORMER.—A line of dry type current transformers, known as the type LD, has been placed on the market by the Packard Electric Company, Warren, Ohio. They have been developed especially for switchboard work for controlling relays, circuit breakers, etc., and where accuracy is not of prime importance, and are recommended for all usual light-duty work, such as supplying an ammeter, single watt-hour meter or for relay work where the burden does not exceed 25 va. Secondary binding posts are provided. The company also has revamped its K line of dry type current transformers, which are intended for accurate metering service.

Electrical Patents

Announced by U. S. Patent Office

(Issued April 10, 1928)

1,665,200. CORD HOLDER FOR VACUUM CLEANERS, LAMPS, AND THE LIKE; H. O. Briggs, Minneapolis, Minn. App. filed April 9, 1925.

1,665,219. HEATING ELEMENT FOR ELECTRIC IRONS; W. A. Rankin, Rochester, N. Y. App. filed May 19, 1923.

1,665,223. CIRCUIT BREAKER; F. W. Roller, East Orange, N. J. App. filed Oct. 24, 1924. Trip free type.

1,665,226. MAGNETIC CHUCK; F. L. Simmons, Woonsocket, R. I. App. filed Jan. 10, 1927.

1,665,291. OPERATING GEAR OF ELECTRIC SWITCHES; A. Allan, North Shields, and H. W. Clothier, Walls-End-On-Tyne, England. App. filed Jan. 21, 1926. Oil-break switchgear in which the main oil-break switch with its tank can be removed entirely from the rest of the gear and if desired replaced by another similar oil switch and tank.

1,665,304. SHORT CIRCUITING DEVICE FOR ELECTRIC MOTORS; H. L. Johnston and M. K. Akers, Troy, Ohio. App. filed March 23, 1925.

1,665,313. PROTECTIVE DEVICE FOR THREE-PHASE ALTERNATING-CURRENT UNITS; J. D. Lewis, Yonkers, N. Y. App. filed April 27, 1923.

1,665,325. ELECTRICAL NETWORK AND ITS OPERATION; E. Peterson, New York, N. Y. App. filed March 18, 1926.

1,665,341. THERMOSTAT; V. A. Boker, Minneapolis, Minn. App. filed April 2, 1925. Adapted for controlling the heating of the crucible of type setting machines.

1,665,347. RAIL BOND; E. M. Deems, Forest Hills, N. Y. App. filed Oct. 15, 1925.

1,665,348. ELECTRICAL WATER HEATER; H. E. Dineson, Bridgeport, Conn. App. filed June 11, 1926.

1,665,367. ELECTRIC HEATER; W. S. Johnson and J. W. Sheffer, Berwick, Pa. App. filed March 25, 1921.

1,665,381. AUTOMATIC FIRE ALARM; J. Siddall, Arlington, and W. H. Siddall, Kearny, N. J. App. filed Nov. 10, 1921.

1,665,446. FUSE CLIP; N. J. Conrad, Wilmette, Ill. App. filed May 25, 1925. For high-voltage fuse.

1,665,472. ELECTRICAL HAIR CURLER; A. H. Opperman, Indianapolis, Ind. App. filed April 25, 1925.

1,665,484. DEVICE FOR APPLICATION TO THE OPENINGS OF OUTLET BOXES AND THE LIKE; R. D. Thompson, Toledo, Ohio. App. filed Oct. 19, 1923.

1,665,495 ELECTRIC SOCKET; E. H. Freeman, Trenton, N. J. App. filed July 10, 1926.

1,665,510. CORD GUIDE; A. S. Spidel, Brewster, Ohio. App. filed Oct. 18, 1926. Cord guide members for the caps of separable attachment plugs.

1,665,528. ELECTRIC FUSE; H. T. Bussmann, St. Louis, Mo. App. filed March 20, 1922. Renewable ferrule contact type.

1,665,529. QUICK-MAKE AND QUICK-BREAK SWITCH; F. LeG. Bryant, Johnson City, N. Y. App. filed March 10, 1927.

1,665,550. CONTACT HOLDER; J. T. Janette, Chicago, Ill. App. filed March 30, 1925. For holding contacts or brushes adapted for various purposes.

1,665,560. VARIABLE TRAFFIC SIGNAL; R. O. Nelson, Portland, Ore. App. filed May 16, 1925. Automatic signal device for the intersection of a main or arterial highway and a cross road.

1,665,562. STARTER FOR ELECTRIC MOTORS; W. C. O'Brien, Baltimore, Md. App. filed Nov. 4, 1924.

1,665,592. CROSSING SIGNAL; J. W. Kennedy, Canton, Ohio. App. filed Aug. 13, 1923.

1,665,603. STORAGE BATTERY; P. E. Norris, Wilkinsburg, Pa. App. filed May 26, 1924.

1,665,604. STORAGE-BATTERY SEPARATOR; P. E. Norris and H. H. Aldrich, Wilkinsburg, Pa. App. filed Oct. 1, 1924.

1,665,613. COUPLING DEVICE FOR ROTATABLE ELEMENTS; H. L. Tanner, Brooklyn, N. Y. App. filed June 11, 1920.

1,665,619. APPARATUS FOR WAVING HAIR; C. A. Ackley, New York, N. Y. App. filed March 25, 1926.

1,665,622. CALLING DEVICE; L. L. E. Chauveau, Paris, France. App. filed Feb. 23, 1922. Selective.

1,665,629. BOOTLEG; F. C. Lavarack, Montclair, and W. H. B. Lavarack, Norwood Borough, N. J. App. filed June 3, 1925. As used in railway signalling.

1,665,662. ELECTROMAGNETIC DETECTING DEVICE; C. E. Godkin, Hayward, Calif. App. filed Dec. 15, 1925. For use in detecting oil.

1,665,677. ALARM DEVICE; W. C. Roe, New York, N. Y. App. filed Jan. 10, 1923. For burglar alarm systems.

1,665,691. TWO-VOLTAGE DIRECT-CURRENT GENERATOR; L. Dreyfus, Vasteras, Sweden. App. filed Feb. 23, 1927. Intended to operate in parallel with a storage battery.

1,665,703. PORTABLE ELECTRIC LAMP; J. Kernes, Chicago, Ill. App. filed Nov. 8, 1926.

1,665,735. BREAD TOASTER; T. C. Forbes, Hopkins, Minn. App. filed Jan. 5, 1927. Automatic.

1,665,737. AUTOMATIC SWITCHING-CORD REEL; J. J. Gough, Chicago, Ill. App. filed Nov. 4, 1925.

1,665,742. INDUCTION MOTOR; F. S. Kingston, Warren, Ohio. App. filed April 28, 1927. Single phase induction motor employing the split phase method of starting.

1,665,746. CURLING-IRON HEATER; H. G. Levy, San Francisco, Calif. App. filed March 7, 1924.

1,665,768. ELECTRIC IRON; G. Browning, Wilmette, Ill. App. filed Aug. 15, 1925.

1,665,772. STORAGE-BATTERY CONSTRUCTION; C. C. Carpenter, Niagara Falls, N. Y. App. filed Feb. 9, 1918.

1,665,792. ELECTRIC CIGAR LIGHTER; G. Parker, Meriden, Conn. App. filed April 8, 1926.

1,665,793. AUTOMATIC ELECTRIC STEAM BOILER; O. A. Sandborgh, Stockholm, Sweden. App. filed Aug. 29, 1921.

1,665,799. INCANDESCENT LAMP; A. B. Smith, South Brownsville, Pa. App. filed Oct. 28, 1925. Filament supporting stem equipped with suitable reflective material in order to augment the volume of the light ray.

1,665,802. DETACHABLE ELECTRIC FIXTURE; W. Symmes, San Francisco, Calif. App. filed Nov. 8, 1921.

1,665,841. ELECTRIC CUT-OUT; G. R. Brown, Bridgeport, Conn. App. filed Sept. 17, 1925. Plug type.

1,665,845. ANTISLUDGING MEANS FOR OIL; D. C. Cox, Soldier Summit, Utah. App. filed Sept. 28, 1926.

1,665,851. ELECTRIC BUTT-WELDED TUBING AND METHOD OF MAKING THE SAME; J. W. Harris, Washington, D. C. App. filed Sept. 26, 1924.

1,665,852. REGULATING SYSTEM; M. Herklotz, Berlin, Germany. App. filed Feb. 27, 1926. For controlling a characteristic of the output of an alternating-current generator in which the characteristic, which may be the voltage, current, power, power factor, etc., is controlled by varying the excitation of an exciter.

1,665,854. ALTERNATING-CURRENT DEVICE; B. E. Lenehan, Wilkinsburg, Pa. App. filed Dec. 15, 1924. Means for readily adapting standard wattmeters for operation as reactive-volt-ampere meters.

1,665,857. ELECTRICAL TRANSMISSION SYSTEM; J. C. Needham, London, England. App. filed May 26, 1920. By means of which the speed of a moving body can be readily ascertained from a distance or variations in speed can be employed to transmit orders.

1,665,858. CIRCUIT INTERRUPTER; W. L. Newmeyer, Wilkinsburg, Pa. App. filed July 11, 1924. Of the latching type.

1,665,861. ELECTRIC HEATER; M. K. Purdy, Stroudsburg, and W. H. Reagle, Tobyhanna, Pa. App. filed Aug. 31, 1927.

1,665,869. ELECTRIC WELDING; J. M. Weed, Scotia, N. Y. App. filed May 18, 1925. Arc welding system.

1,665,890. SYNCHRONOUS MOTOR SPECIALLY FOR DRIVING CLOCKS; R. Michl, Kosice, Czechoslovakia. App. filed June 10, 1925.

1,665,893. SYSTEM OF DISTRIBUTION; D. C. Prince, Schenectady, N. Y. App. filed Sept. 23, 1924.

1,665,901. SPEED-REGULATOR SYSTEM; J. H. Ashbaugh, Pittsburgh, Pa. App. filed Sept. 26, 1925.

1,665,917. REGULATOR SYSTEM; R. D. Evans, Pittsburgh, Pa. App. filed April 12, 1921. Which will accurately function on either a balanced or an unbalanced electrical system.

1,665,918. COMPENSATED VOLTAGE REGULATOR SYSTEM; R. D. Evans and H. K. Sels, Pittsburgh, Pa. App. filed March 15, 1923.

1,665,939. REGULATOR SYSTEM; S. A. Staege, Pittsburgh, Pa. App. filed April 15, 1926. Rotary contactor type regulator system.

1,665,941. ELECTRIC HEATER; A. E. M. Van Der Meersch, Chelsea, London, England. App. filed Dec. 8, 1926.

1,665,949. WATER HEATER; J. G. Chalmers and B. C. Salamis, Montreal, Quebec, Canada. App. filed Aug. 27, 1926.

1,665,956. FIRE ALARM; S. Giangrasso, Portland, Me. App. filed Aug. 28, 1926. Of the audible signal type.

1,665,962. STORAGE-BATTERY PLATE AND METHOD OF PRODUCING SAME; C. W. Jenner, New Westminster, B. C., Can. App. filed June 2, 1927.

1,665,987. PILOT LIGHT; J. T. Smith, San Francisco, Calif. App. filed June 28, 1926. For use with heating equipment such as flat-irons.

1,666,007. SEPARATOR AND METHOD OF MAKING THE SAME; W. S. Gould, New York, N. Y. App. filed Oct. 23, 1923.

1,666,026. PROCESS OF WELDING; R. Applegate, Cleveland, Ohio. App. filed Oct. 10, 1921. By the electric arc involving the use of a degasifying substance.

1,666,041. TRAFFIC SIGNAL; F. Buchanan, Syracuse, N. Y. App. filed Sept. 24, 1924.

New Trade Literature

CONDUIT FITTINGS FOR RAILWAY MAIL CARS.—The Crouse-Hinds Company, Syracuse, N. Y., has issued bulletin No. 2112, entitled "Railway Mail Car Lighting and Fan Installations." The bulletin describes and illustrates the various types of fixtures, condulets and switches for railway mail car lighting and fan installations.

SWITCHING AND OUTDOOR STATION EQUIPMENT.—The General Electric Company, Schenectady, N. Y., has issued bulletin GEA-966, covering its indoor metal-clad switching equipment. The company also is distributing bulletin GEA-899, describing and illustrating its types HD-1 and HD-2 disconnecting switches for outdoor station equipment.

INSULATORS AND TRANSMISSION LINE HARDWARE.—Catalog No. 4 issued by the **Lapp** Insulator Company, Inc., LeRoy, N. Y., describes its vacuum process high-voltage porcelain insulators, its special high-voltage porcelain designs and its transmission line hardware and appliances. The catalog is well illustrated and contains several Lapp factory views. Porcelain processes are described and compared with the Lapp vacuum process and the Lapp clay-mixing process. A chapter also is devoted to Lapp standard practices. The various types of insulators, bushings, etc., are fully described and a line drawing gives all the dimensions. Attention is called to the Lapp method of packing.

ELECTRIC EQUIPMENT. — Bulletin GEA-884 issued by the General Electric Company, Schenectady, N. Y., covers its direct-current induction and synchronous motors and control particularly adapted to building and flat-glass manufacture. Illustrations are given showing the application of the motors to air compressors in a glass plant.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

An agency is desired in Hamburg, Germany (No. 30,832), for electrical advertising novelties and household electrical appliances, including refrigerators and washing machines.

An agency is desired in Santo Domingo, Dominican Republic (No. 30,795), for electromedical apparatus.

An agency is desired in Bogota, Colombia (No. 30,796), for high-grade flashlights.

An agency is desired in Prague, Czechoslovakia (No. 30,833), for household electrical accessories, including dishwashers.

Purchase is desired in Shanghai, China (No. 30,791), of lighting switches and receptacles.

An agency is desired in Vienna, Austria (No. 30,793), for electric household refrigerators.

An agency is desired in Sheffield, England (No. 30,797), for electric household refrigerators and units.

An extensive hydro-electric project involving $30,000,000 is planned in British Columbia, Canada (No. 274,934).